WATER MASTER PLAN

ISLAND OF HAWAII

DEPARTMENT OF WATER SUPPLY

Water brings progress!

DECEMBER, 1980

WATER MASTER PLAN

ISLAND OF HAWAII

Prepared For

DEPARTMENT OF WATER SUPPLY
County of Hawaii

DECEMBER 1980

Prepared By

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PREFACE

The Water Master Plan for the County of Hawaii is a document which provides a long-range plan for public water systems on the Island of Hawaii. It provides a comprehensive outlook of the island's total water resource and presents a brief description of each public water system.

This edition of the Water Master Plan is a revision of the 1971 publication, marking the beginning of the 1980-1990 water planning period. The revisions incorporated in this document reflect the changes that have occurred to the municipal water supply systems since 1971 and sets the direction for water development for the next decade.

A major change has been made in this report to maintain a consistency with the State of Hawaii's Water Resources Development Plan. The State's plan assesses the availability of water according to Hydrographic Areas, or major drainage basins. The island's water systems have therefore been grouped by the respective Hydrographic Areas to maintain intergovernmental consistency.

This report presents a description of the island's five Hydrographic Areas as well as each of the Department of Water Supply systems. Their present water resources and capabilities to serve both existing and anticipated uses are also discussed. As a last but important item, water supply improvements as presented in the Community Development Plans (CDP) for the County of Hawaii have also been incorporated into this document.

Planning for future water needs will continue to be one of the most essential aspects of water master planning. It is only through careful planning and skill in implementing those plans that future generations can enjoy a comfortable, progressive lifestyle.

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SUMMARY

GEOLOGY AND HYDROLOGY

Hawaii, the largest island in the Hawaiian chain, is 93 miles long, 76 miles wide, and covers 4,030 square miles. According to geologists, the island was formed by five volcanoes, the rocks of volcanic origin except for minor amounts of sedimentary formations.

Lying in the path of the northeast trade winds, Hawaii has an orographic rainfall pattern typical of the larger islands in the Hawaiian chain. The moisture-laden trades are cooled as they rise up the mountain slopes, losing part of their moisture as rain. The prevalence of trades throughout much of the year accounts for the high annual rainfall of 75 inches to over 300 inches on the windward or northeast side of the island. As the winds descend along the leeward slopes, the air becomes drier and warmer. Rainfall declines accordingly, resulting in a near arid climate along the leeward coastline. The mean annual rainfall in most leeward areas is approximately 10 inches. Along the Kona coast, however, the difference between land and water temperatures on warm days particularly in summer, generates a moderate sea breeze circulation which results in frequent showers. This rainfall is typically spotty in distribution and highly variable in duration and intensity. The showers are frequent and heavy enough to produce a much higher mean rainfall in Kona than in other leeward areas.

HYDROGRAPHIC AREAS

There are five hydrographic areas on the island, corresponding to the Big Island's major drainage basins (Figure 1). The municipal water systems have been grouped by hydrographic areas to coordinate this report with the State Water Resources Development Plan. The State's plan assesses water availability by Hydrographic Areas. Since the boundaries between the areas are natural divides and occur irrespective of populated areas, there are instances where distribution systems are not confined within one hydrographic region. Where this condition occurs, the affected system(s) have generally been included within the hydrographic area in which the system's source is located.

HYDROGRAPHIC AREA MAP

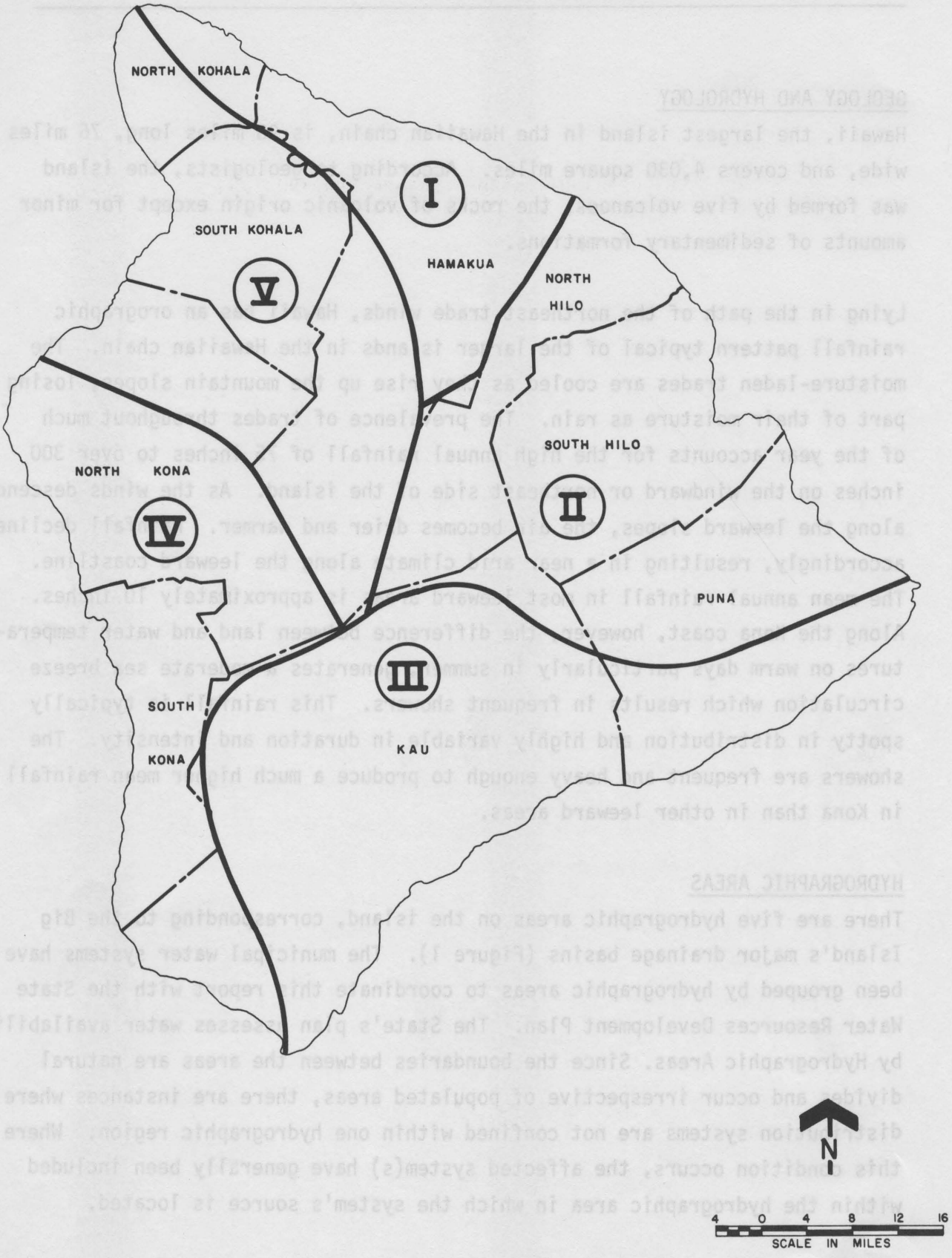


FIGURE 1

AVAILABLE WATER RESOURCES

It is estimated that the Island of Hawaii receives a daily average of 14,100 million gallons of rainfall. A fair amount runs off into streams but the majority percolates into the ground to the basal aquifer. The high rainfall areas between the 2,000 and 4,000-foot elevations on the windward side of the island and also on the western slope of Hualalai contribute the bulk of the water to the island's streams, springs and basal aquifer. The rainfall distribution and groundwater areas on the Island of Hawaii are illustrated on Figure 2. Table 1 presents estimates of rainfall distribution, evapotranspiration, runoff and groundwater recharge in each of the five hydrographic areas.

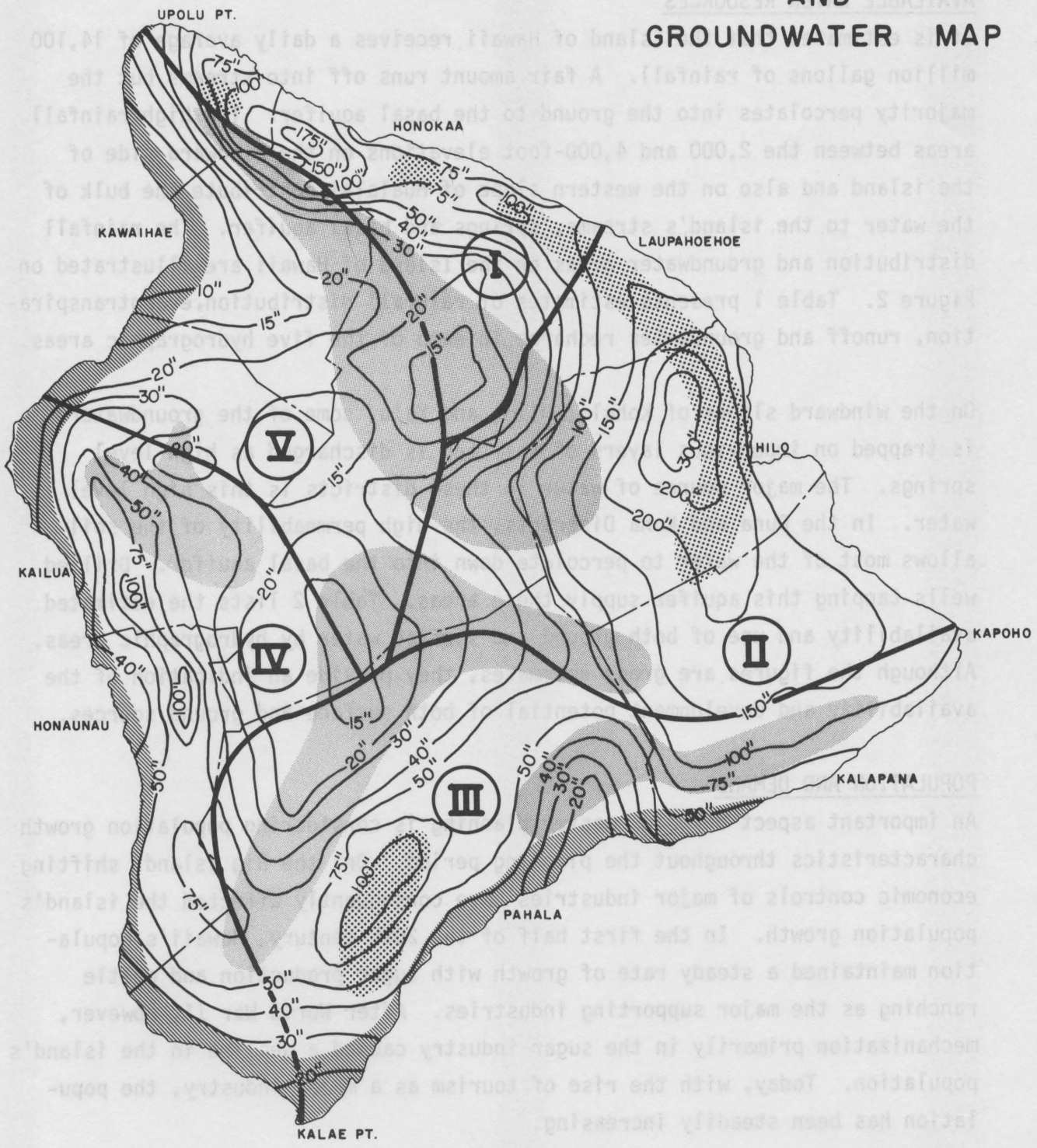
On the windward slopes of Kohala, Hilo, and Ka'u, some of the groundwater is trapped on impervious layers of soil and is discharged as high level springs. The major source of water in these districts is this high level water. In the Puna and Kona Districts, the high permeability of the soil allows most of the water to percolate down into the basal aquifer. Drilled wells tapping this aquifer supply these areas. Table 2 lists the estimated availability and use of both ground and surface water by hydrographic areas. Although the figures are gross estimates, they provide an indication of the availability and development potential of both surface and ground sources.

POPULATION AND DEMAND

An important aspect of water master planning is considering population growth characteristics throughout the planning period. On the Big Island, shifting economic controls of major industries have consequently affected the island's population growth. In the first half of the 20th century, Hawaii's population maintained a steady rate of growth with sugar production and cattle ranching as the major supporting industries. After World War II, however, mechanization primarily in the sugar industry caused a decline in the island's population. Today, with the rise of tourism as a major industry, the population has been steadily increasing.

The major growth areas, specifically Hilo, Kona and South Kohala, are expected to experience substantial increases in water demands. Consequently, the majority of proposed water supply improvements are concentrated within these areas. Tables 3 and 4 lists the projected population and demand figures, respectively, by hydrographic areas.

RAINFALL DISTRIBUTION AND GROUNDWATER MAP



LEGEND

- BRACKISH BASAL WATER
- BASAL WATER FLOATING ON SALT WATER
- WATER CONFINED BY DIKES AND NOT FLOATING ON SALT WATER
- WATER PERCHED ON ASH, SOIL OR ALLUVIUM AND UNDERLAIN WITH BASAL WATER

N

4 0 4 8 12 16
SCALE IN MILES

FIGURE 2

TABLE 1

DISTRIBUTION OF RAINFALL TO EVAPOTRANSPIRATION,
RUNOFF, AND GROUNDWATER RECHARGE*
(million gallons per day)

Hydrographic Area Representing Major Drainage Basin	Total Rainfall	DISTRIBUTION OF RAINFALL						1975 GROUNDWATER QUANTITIES (APPROXIMATE)		
		Evapo-transpiration	Percentage of Rainfall	Runoff	Percentage of Rainfall	Groundwater Recharge	Percentage of Rainfall	Exported	Imported	Withdrawn from Wells
I	1,430	695	49	430	30	305	21	5	1	5
II	7,335	1,730	24	2,510	34	3,095	42	0	0	18
III	2,340	(1) 1,705	73	235	10	400	17	0	0	8
IV	1,790	(1) 1,265	71	180	10	345	19	0	0	3
V	1,160	(1) 745	64	180	16	235	20	1	5	1
TOTALS (ROUNDED)	14,100	6,200	44	3,500	25	4,300	31	6	6	35

(1) Probably too high owing to infrequency of storms which provide much of rainfall total.

*USGS, 1978, "Summary Appraisals of the Nation's Ground-Water Resources."

TABLE 2

WATER USE AND ESTIMATED AVAILABILITY,
BY HYDROGRAPHIC AREAS
(million gallons per day)

Hydrographic Area	GROUNDWATER		SURFACE WATER	
	Estimated Sustainable Yield	Use* (1975)	Estimated Sustainable Yield	Use* (1975)
I	200	**	170	52
II	1,800	93	500	97
III	110	5	0	2
IV	100	5	0	0
V	40	4	20	2
TOTAL	2,250	107	690	153

*Includes inter-area transfer.
**Less than 1.0 mgd.

Source: Hawaii Water Resources Plan, January 1979, and USGS Water Use Survey, 1975.

TABLE 3

PROJECTED RESIDENTIAL POPULATION, BY HYDROGRAPHIC AREAS*

Year	Island Total	HYDROGRAPHIC AREA[1/] I	II	III	IV	V
1980	84,700	9,000	54,500	4,300	12,900	4,000
1985	95,200	9,300	59,200	6,800	14,600	5,300
1990	105,100	9,400	63,500	9,300	16,100	6,800
1995	115,000	9,600	69,400	10,000	17,600	8,400
2000	123,300	9,700	74,300	10,500	18,900	9,900

1/Errors in area totals may exist due to inconsistency between area and district boundaries.

*Resident totals for each area comprised of district projections disaggregated by the County of Hawaii from the Series II-F projections.

TABLE 4

PROJECTED MUNICIPAL WATER DEMAND
(in thousand gals/day)

Year	Island Total	HYDROGRAPHIC AREA 1/				
		I	II	III	IV	V
1980	13,900	1,477	8,944	706	2,116	657
1985	17,100	1,670	10,634	1,221	2,622	953
1990	19,500	1,744	11,782	1,725	2,987	1,262
1995	21,600	1,803	13,035	1,878	3,306	1,578
2000	23,400	1,840	14,101	1,993	3,587	1,879

1/ Derived as follows: population x gallons water per capita per day = water demand

$\frac{\text{gals/day}}{\text{persons}}$ = gals/person/day

$\frac{13,900}{84.7}$ = 164 gals/person/day

$\frac{17,100}{95.2}$ = 180

$\frac{19,500}{105.1}$ = 186

$\frac{21,600}{115}$ = 188

$\frac{23,400}{123.3}$ = 190

How derived?

Water conservation impact?

WATER SUPPLY PROBLEMS AND SOLUTIONS

The Department of Water Supply maintains and operates over 20 separate systems in the County of Hawaii. All of the systems are supplied by either high level springs, streams, tunnels, or deep wells.

In terms of water quality and quantity, the island's deep well sources are more dependable than other source types. The major problems associated with high level sources and streams are: (1) potential inadequate quantity of supply during droughts and (2) poor water quality (high turbidity) during heavy rainfall periods. Compliance with the primary regulations of the Safe Drinking Water Act, although not fully achieved, is an ongoing item being pursued by the Department. Minor violations to the regulations have occurred but generally have been limited to inadequate sampling and treatment operations that are easily and immediately corrected.

Aside from basic quantity and quality problems, the Department has been confronted with inadequate main sizes within its respective systems. The problem of tuberculation on the inner pipe walls, leading to inadequate water transmission capacities, is largely confined to old galvanized iron pipes. The problem is compounded by added water requirements as a consequence of rising standards of living and general growth.

Within the past decade, the Department of Water Supply has instituted improvement programs to relieve the problems as described above. In improving those systems relying on surface sources, the Department has completed a groundwater source development program. The groundwater sources have been made to allow system flexibility by providing groundwater when surface sources are deficient in quantity and/or quality. Another completed program involved the construction of large storage reservoirs to accommodate water requirements during drought periods. This program was considered as another alternative in improving systems relying on surface sources. Water treatment facilities were also a part of the storage reservoir program to achieve acceptable drinking water quality of the raw surface supply. The Department has taken steps towards the full compliance with the Safe Drinking Water Act. In a continuing effort to assure water of

acceptable quality, periodic sampling of the island's existing water resources are made by the State Department of Health.

In resolving inadequate transmission capacities, the Department is presently continuing a pipeline replacement program which has, to date, resulted in excellent service performance and lower maintenance and repair expenditures.

PROPOSED IMPROVEMENTS

Improvements proposed by the Department of Water Supply are listed within the discussions of the respective water systems. The proposed improvements were developed on the basis of: (1) accommodating anticipated increases in water demand, (2) providing good quality water meeting the standards of the U. S. Public Health Service, and (3) improving the system to provide adequate distribution, pressure and volume. These proposals are consistent with those as presented in the respective Community Development Plans for the Island of Hawaii.

Presented in the following sections are descriptions of each hydrographic area and discussions of each water system. A brief discussion of the Community Development Plans as they relate to the County of Hawaii General Plan is given in the Appendix. The policies and standards relating to public water supplies as set forth in the General Plan and other considerations are also provided.

HYDROGRAPHIC AREA I

PRESENT DEVELOPMENT

Population

Hydrographic Area I embodies the areal limits as shown on Figure 1. The region is composed of portions of the Hamakua and North Kohala Districts and the eastern fringe of the South Kohala District. Major populated areas within Hydrographic Area I include Hawi, Kukuihaele, Honokaa, Paauilo and Ookala. These developed areas originated many years ago as agricultural settlements.

The 1970 census determined a population of approximately 8,000 people for the Hamakua and North Kohala Districts. Population figures and resultant demand projections are based on the aggregated population of the North Kohala and Hamakua Districts. A projected 1980 population of 9,000 people for Hydrographic Area I has been estimated based on the State's II-F projections (Table 3).

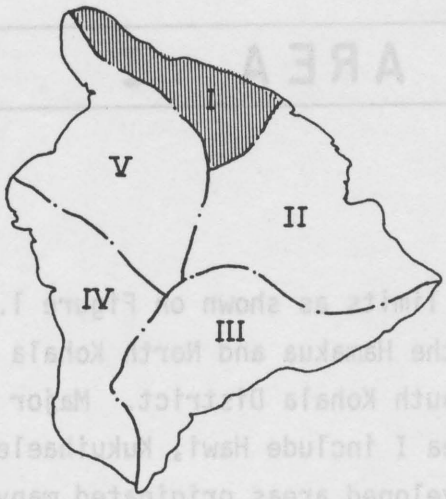
Water Supply

The annual rainfall within this region ranges from 15 inches along the upper northern slopes of Mauna Kea to 175 inches along the lower northeastern slope of the Kohala Mountains. As indicated on Table 1, Hydrographic Area I receives a total rainfall of approximately 1,430 million gallons per day (mgd). Out of this, about 370 mgd remains as the area's estimated sustainable yield (Table 2).

Table 4 lists the projected demands for Hydrographic Area for the 1980-2000 period. The figures are based on population estimates developed by the County of Hawaii (disaggregated from State II-F projections). A comparison of the projected 1980 demand of approximately 1.5 mgd with the estimated sustainable yield of 370 mgd for the region is indicative of the vast surplus water supply available within the Hamakua area.

Presently, there are three primary municipal water systems within the limits of Hydrographic Area I. Included are the North Kohala, Kukuihaele, and Hamakua Water Systems (Figure 3).

HYDROGRAPHIC AREA I
WATER SYSTEMS



KUKUIHAELE SYSTEM
(SPRINGS)

HAMAKUA SYSTEM
(SURFACE WATER)

OOKALA SYSTEM
(WELL)

Upolu Point

Kukuihaele

Kapulena

HONOKAA

Paauhau

Paauilo

Kukaiau

WAIMEA

MAUNA KEA

NORTH KOHALA SYSTEM

HAWI-KOKOIKI SUBSYSTEM
(TUNNEL, WELL)

KAAUHUHU SUBSYSTEM
(TUNNEL)

KYNNERSLEY-KAPAAU SUBSYSTEM
(TUNNEL)

HALAULA SUBSYSTEM
(TUNNEL)

MAKAPALA-KEOKEA SUBSYSTEM
(TUNNEL)

N

0 5 10 Miles

FIGURE 3

Developed Sources

Each of the three water systems generally obtain water from separate sources. These sources presently satisfy demand requirements of the respective population centers. The capacities are as follows:

System	Source	Capacity (mgd)
North Kohala Water System		
- Kaauhuhu	Lindsey Tunnel	.093*
- Hawi-Kokoiki	Watt No. 1 Tunnel	0.175*
	Hawi Deep Well	0.576 (400 gpm-24 hrs.)
- Kynnersley-Kapaau	Hapahapai Tunnel	0.045*
	Tunnel 17	0.006*
	Tunnel 18	0.018*
- Halaula	Bond Tunnel	0.200*
- Makapala-Keokea	Murphy Tunnel	0.070*
Kukuihaele Water System	Kukuihaele Springs	0.144 (100 gpm-24 hrs.)
Hamakua Water System		
- Honokaa, Paauhau, Ahualoa-Kaao	Waimea Treatment Plant	2.70+
- Ookala	Plantation Source	N/A
	TOTAL	4.027 mgd

* Minimum flows obtained from Stearns and MacDonald, Geology and Ground-Water Resources of the Island of Hawaii, 1946

+ 4.00 mgd (Waimea Treatment Plant Capacity) - 1.30 mgd (Hydrographic Area V 1990 Demand) = 2.70 mgd.

1990 DEVELOPMENT

Population

The low growth rate of Hydrographic Area I is apparent in Table 3. The future development outlook is one of minimal change, with growth and improvements limited to housing and small businesses.

Demand

The projected 1990 demand of approximately 1.7 mgd will not create a shortage of water (Table 4). The limiting factors such as inadequate line size and additions to the present system will constitute the major aspect of water system improvements within this planning period.

NORTH KOHALA SYSTEM

The Department of Water Supply obtains its water for the North Kohala District from high level tunnels in the Kohala Mountains and a groundwater source (deep well) in Hawi.

In improving water resources in North Kohala, the State of Hawaii has initiated a program to renovate the Kehena Ditch and intake into a closed system. To date, $1,000,000 has been spent to install 14,800 lineal feet of 12- and 16-inch pipe. This source could serve the high level areas of North Kohala.

North Kohala is served by the following four subsystems: Kaauhuhu, Hawi-Kokoiki, Kynnersley-Kapaau and Halaula. Generally, the systems have adequately sized mains to supply present domestic needs. However, improvements may become necessary depending on the age and condition of the existing transmission lines. A fifth subsystem (Makapala-Keokea Water System) will be constructed shortly.

Kaauhuhu Subsystem

Source

The Department of Water Supply obtains water requirements for the Kaauhuhu Subsystem from the Lindsey Tunnel under a lease agreement with the Kohala Corporation. This agreement expires in 1984. Some of the significant terms of the agreement are: (1) the Department of Water Supply has first preference of the water and (2) the Department pays the Kohala Corporation $25.00 per million gallons of water used. The flow data, obtained from Stearns and MacDonald are as follows:

Maximum Flow ----------	0.166 mgd
Minimum Flow ----------	0.093 mgd
Average Flow ----------	0.130 mgd

The capacity of the 4-inch transmission line from the tunnel to Kaauhuhu is 100,000 gpd. The system also serves the Hawi-Kokoiki Subsystem (primarily Kokoiki).

Demand

The Kaauhuhu area consumes an average of 37,000 gpd.

The Kaauhuhu Subsystem is planned for connection with the Hawi-Kokoiki Subsystem via the proposed transmission line and booster pump from Watt Tunnel No. 1. This will provide a supplemental source of water during droughts or high consumption periods.

Hawi-Kokoiki Subsystem

Sources

The Hawi-Kokoiki Subsystem acquires its water from Watt Tunnel No. 1 and a deep well in Hawi. The Department of Water Supply is presently in the process of acquiring water rights for the tunnel. The flow data from Stearns and MacDonald for Watt Tunnel No. 1 are as follows:

Maximum	2.50 mgd
Minimum	0.175 mgd
Average	1.25 mgd

The capacity of the deep well source in Hawi is 0.576 mgd based on the 400 gpm deep well pump operating 24 hours per day.

The existing transmission line from Watt Tunnel No. 1 is composed of 5-inch diameter pipes and totals about 13,000 lineal feet. The system also serves the Kynnersley-Kapaau Subsystem.

Demand

Hawi presently consumes an average of approximately 84,000 gpd. The capacity of the Hawi-Kokoiki Subsystem, based on the size of the transmission/distribution line, is about 0.90 mgd. Consumption in Kokoiki is presently about 41,000 gpd.

Kynnersley-Kapaau Subsystem

The present Kynnersley-Kapaau Subsystem is comprised of the Kapaau System which was acquired from the Kohala Sugar Corporation in 1927 and the Kynnersley Subdivision System which was developed by the Kohala Corporation.

Sources

The sources serving this system include Tunnels 17, 18 and Hapahapai Tunnel. Watt Tunnel No. 1 from the Hawi-Kokoiki Subsystem can also serve this subsystem. Water rights from Tunnels 17 and 18 were acquired when the system was bought in 1927. As stated previously, the Department of Water Supply is presently in the process of acquiring water rights for the Watt and Hapahapai Tunnels. As an emergency measure, water can also be taken from the Kohala Ditch.

Flows of the respective sources, as obtained from Stearns and MacDonald, are as follows:

	Minimum	Maximum	Average
Hapahapai ----------	1.5 mgd	0.045 mgd	0.5 mgd
Tunnel 17 ----------	--	0.006 mgd	--
Tunnel 18 ----------	--	0.018 mgd	--
	1.5 mgd	0.069 mgd	0.5 mgd

Demand

The present demand for the Kynnersley and Kapaau areas is about 90,000 gpd and 28,000 gpd, respectively, or a total of 118,000 gpd.

Halaula Subsystem

Source

The Halaula Subsystem consists primarily of the Halaula Subdivision System which was developed and dedicated by the Kohala Corporation. The Department obtains its water for this system from the Bond Tunnel at $25.00 per million gallons. Flow data from Stearns and MacDonald are as follows:

Maximum	4.175 mgd
Minimum	0.200 mgd
Average	1.265 mgd

Demand

The average usage of 60,000 gpd is significantly less than the system's capacity of 160,000 gpd. Most of the distribution mains

are adequate to serve domestic and fire flow needs, although the tunnel supply becomes inadequate during dry periods. During these emergency periods, water is supplemented from the Kohala Ditch. There are indications that groundwater may be developed as a supplement to the tunnel supply.

Makapala-Keokea Subsystem

The Makapala-Keokea Water System is a new water system that will be constructed with State funds. The system will obtain its source from the existing Murphy Tunnel which has minimum average flows of 70,000 gpd and 250,000 gpd, respectively, as listed in the publication by Stearns and MacDonald. A 50,000-gallon concrete reservoir, chlorinator facilities, 4-inch transmission and 8-inch and 6-inch distribution water lines, and necessary water system appurtenances will be constructed.

This new system will upgrade an existing system with old and inadequately sized pipelines owned by the Kohala Corporation. Since the plantation has no direct interest in the area, the Department and the State have taken the responsibility of improving the area's water needs to meet applicable engineering design and water quality standards.

The Makapala-Keokea Subsystem will adequately serve the existing 60 residences in the area with fire protection and domestic service.

Proposed Improvements

Developments and improvements for the North Kohala Systems are planned as follows: (Refer to Plate 1)

- Source
  Kaauhuhu Source Improvement
  Booster and Transmission

- Reservoir
  Kokoiki Reservoir
  Kaauhuhu Reservoir

- Transmission

  Kokoiki Transmission

  Makapala-Keokea Water System

  The State is developing a historical park at Lapakahi. To fully develop the area, a new water main extending from Kokoiki is proposed to service the area. Landscaping has been a constant problem without an adequate water system serving the park. The proposed pipeline could also be expanded to service urban zoned areas adjacent to the park. This would be in keeping with the County General Plan which provides for a minor resort development in the Mahukona-Lapakahi area.

JKUIHAELE WATER SYSTEM

Description

The Kukuihaele Water System was constructed in 1966 with State C.I.P. appropriations. This system consists of 6-inch and 4-inch pipelines, two 100 gpm booster pumps and a 100,000-gallon concrete reservoir in Kukuihaele. In addition, there are two 50 gpm booster pumps and a 50,000-gallon reservoir to serve Kapulena.

Source

Water is obtained from low level springs located at about the 540 feet elevation. There is no flow record for the springs. The supply is lifted by two 100 gpm booster pumps to the 100,000-gallon reservoir at the 940 feet elevation.

Demand

Since recent water system improvements which extended water service to Kapulena, the usage has increased to about 41,000 gpd. The demand is expected to increase appreciably only as the system is extended to take on new customers.

Proposed Improvements

Improvements are limited to the addition of a booster pump and appurtenances as shown on Plate 2.

HAMAKUA SYSTEM

Description

The Hamakua Water System, which may be considered a subsystem of the South Kohala Water System (in Hydrographic Area V), includes the major service areas of Honokaa, Ahualoa-Pohakea, Paauhau, Paauilo-Kaao and Ookala. In general, most of the lines are adequate to serve the present domestic needs. Future water improvements are expected to be limited, as confirmed by the stable population projections figures for the Hamakua District.

Source

The Hamakua Water System obtains its water from the Waimea Treatment Plant. Prior to improvements completed in the previous water planning period, water was obtained from the Upper Hamakua Ditch in the Kohala Mountains. Due to water quality problems, the Hamakua Water System has been linked to the Waimea System. A new 12-inch transmission main extends from Kuhio Village to the existing 8-inch transmission main near the Puukapu or Puu Pulehu Reservoir. Transmission to Ahualoa is through the existing 8-inch and 6-inch mains.

Demand

The capacity of the 8-inch and 6-inch line is 0.58 mgd and the average consumption is presently 0.35 mgd. By considering the present maximum daily consumption of about 0.53 mgd, it is evident that the transmission system to Ahualoa will become inadequate. However, the proposed Haina Well development will alleviate the situation by providing a supplemental supply below the transmission system (see Plate 3).

Approximately 55 percent of the 0.35 mgd used by the Hamakua System is consumed in Honokaa. The average consumption of the Ahualoa, Kaapahu, Pohakea System is 0.077 mgd. Except for a few areas, the system is adequate to serve the present usage.

The capacity of the system serving Honokaa is about 0.5 mgd. The limiting factor is the size of the main trunk line. Many subdistribution lines especially in the old subdivisions are inadequate and will require replacement.

Proposed Improvements

Developments and improvements for the Hamakua System are planned as follows: (Refer to Plate 3)

- Source
  Haina Well Development
  Additional Source Development

- Reservoir
  Haina 0.1-MG

- Booster Pump
  Haina Booster Pump
  Pohakea Booster Pump

- Transmission
  Ahualoa - Camp 10 Transmission
  Haina Transmission
  Ahualoa-Kalopa Transmission
  Kaao-Paauhau Transmission

- Distribution
  Kalopa Pipeline Improvement

PAAUILO SYSTEM

Description

With the Pohakea-Paauilo Village Transmission Line, the Paauilo System will be considered a subsystem of the Hamakua Water System. This system extends from Paauilo Village eastward to Kaao.

Source

Water requirements are obtained from the plantation's deep well situated below Paauilo Village. At present, the Department of Water Supply purchases water from Hamakua Mill Company at a rate of $33.75 per million gallons. This water purchasing will be eliminated upon installation of the Pohakea-Paauilo Village transmission line which will then allow the use of surface supplies from Waimea.

Demand

The present average daily demand is 0.03 mgd. It is anticipated that there will not be a great increase in demand in the foreseeable future unless the Department acquires the private plantation system.

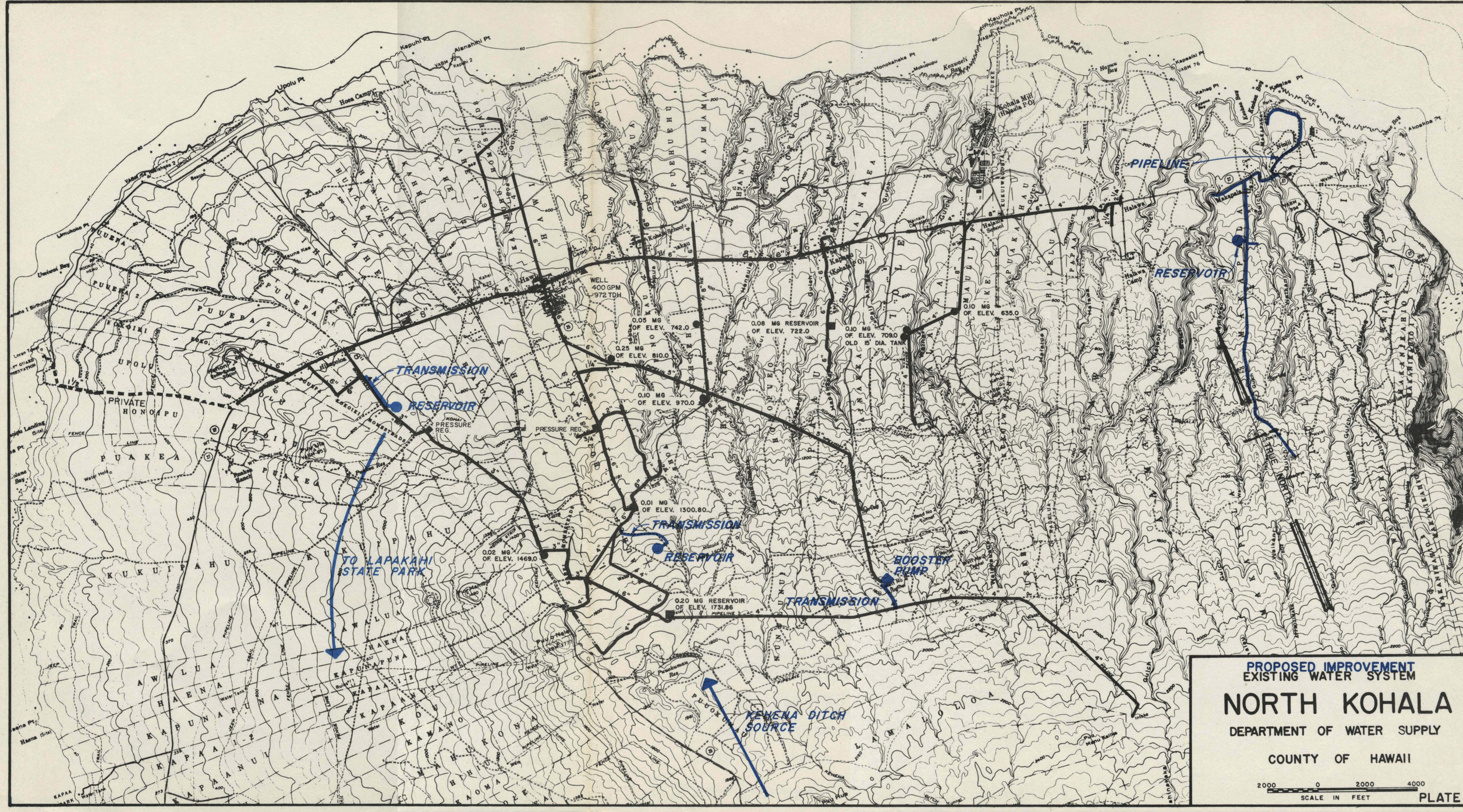
Proposed Improvements

Existing old galvanized pipelines, previously owned and maintained by the Sugar Company, will be replaced.

OOKALA SYSTEM

The Ookala System, serving the Ookala Houselot Subdivision, consists of 2-inch and 4-inch cast iron pipes. This system was dedicated to the County by Kaiwiki Sugar Company in 1955. Although it is in the North Hilo District and Hydrographic Area II, the Ookala System is considered a subsystem of the Hamakua Water System. Water is purchased from the plantation.

There is no anticipated increase in consumption and no improvements planned for this system.


PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
NORTH KOHALA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE
PIPE LINE
RESERVOIR
TRANSMISSION
RESERVOIR
PRESSURE REG.
WELL
400 GPM
972 TDH
0.05 MG
OF ELEV. 742.0
0.25 MG
OF ELEV. 810.0
0.10 MG
OF ELEV. 970.0
0.08 MG RESERVOIR
OF ELEV. 722.0
0.10 MG
OF ELEV. 709.0
OLD 15' DIA. TANK
0.10 MG
OF ELEV. 635.0
0.01 MG
OF ELEV. 1300.80
TRANSMISSION
RESERVOIR
0.02 MG
OF ELEV. 1469.0
0.20 MG RESERVOIR
OF ELEV. 1731.86
BOOSTER
PUMP
TRANSMISSION
TO LAPAKAHI
STATE PARK
KEHENA DITCH
SOURCE
PRIVATE
TRUE NORTH
Kohala Mill
(Hawaii P.C.)
Halaula
Hawi
Kapaau
Upolu Pt.
Kapaa
Hawi Camp
Halaula Camp
Halaula School
Kohala School
Kapaau School
Upolu Landing
Hawi Landing
Kapaa Landing
Kapaa Park
Kapaa Camp
Hawi Camp
Halaula Camp
Hoea Camp
Salon Camp
Kapaau Camp
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Kapaau Camp 98
Kapaau Camp 99
Kapaau Camp 100

BOOSTER PUMP
2-100 GPM 4"

BOOSTER PUMP

0.10 MG TANK
BOT. ELEV. 956.00
O.F. ELEV. 970.50

BOOSTER PUMPS
2-50 GPM
ELEV. 790.75

0.05 MG RESERVOIR
BOT. ELEV. 1045.0
O.F. ELEV. 1059.5

Kukuihaele Landing & Lighthouse

Waikoekoe 3

Camp 106

Camp 109

Kawela Camp

Waihaka Reservoir

Lalakea Reservoir

VABM 1629 Puu Mauu

VABM 1626

VABM 161

Cemetery

Tunnels

Flume

Ditch

Stream

Gulch

Trail

Jeep

Water

Tank

Boundary

Reserve

Forest

Lane

Landing Strip

HAMAKUA

KUKUIHAELE

PROPOSED IMPROVEMENT

EXISTING WATER SYSTEM

KUKUIHAELE

DEPARTMENT OF WATER SUPPLY

COUNTY OF HAWAII

2000 0 2000 4000

SCALE IN FEET

PLATE 2


WELL & RESERVOIR & BOOSTER PUMP
0.02 M.G. RESERVOIR BOT. ELEV. 1450.00 O.F. ELEV. 1463.25
0.03 M.G. TANK BOT. ELEV 1334.00 O.F. ELEV 1349.00
0.042 M.G. TANK BOT. ELEV. 1334.00 O.F. ELEV. 1352.50
2 - 0.047 M.G. TANK BOT. ELEV. 1329.00 O.F. ELEV. 1349.00
TRANSMISSION
0.01 M.G. TANK BOT. ELEV. 1600.50 O.F. ELEV. 1623.50
PRESSURE BREAKER ELEV. 1722.50
TRANSMISSION
0.05 M.G. TANK BOT. ELEV. 1947.00 O.F. ELEV. 1967.50
PRESSURE REG. ELEV. 1945.00
0.05 M.G. TANK BOT. ELEV. 2225.00 O.F. ELEV. 2245.00
0.02 M.G. RES. BOT. ELEV. 2309.00 O.F. ELEV. 2322.25
0.30 M.G RES. BOT. ELEV. 2500.00 O.F ELEV. 2515.00
6" TRANSMISSION MAIN
FILTER PLANT
BOOSTER PUMP G.P.M. 65
0.05 M.G. TANK BOT. ELEV. 2584.00 O.F. ELEV. 2598.50
PIPELINE
0.02 MG RESERVOIR BOT. ELEV. 935 O.F. ELEV. 948
PIPELINE
P.R.V. ELEV. 1730.00
P.R.V. ELEV. 1734.00
0.05 M.G. TANK BOT. ELEV. 2154.50 O.F. ELEV. 2169.10
BOOSTER PUMP
0.025 M.G. TANK BOT. ELEV. 2097.50 O.F. ELEV. 2108.00
BOOSTER PUMP G.P.M. 50
0.01 M.G. TANK BOT ELEV 2692.00 O.F. ELEV. 2700.70
BOT. ELEV. 1058 O.F. ELEV. 1072.5
0.05 M.G TANK BOT ELEV 979.50 O.F ELEV 999.50
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
HAMAKUA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE 3

HYDROGRAPHIC AREA II

PRESENT DEVELOPMENT

Population

Hydrographic Area II, shown on Figure 1, includes the North and South Hilo and portions of the Ka'u and Puna Districts. There are eight water systems within this region presently owned and operated by the Department of Water Supply (Figure 4). It is therefore the most extensive Hydrographic Area on the island. Significant population areas include: Laupahoehoe, Ninole, Honomu, Pepeekeo, Papaikou, Paukaa, Hilo, Keaau-Mt. View, and Pahoa.

The 1970 census population of approximately 41,000 people reflects an aggregate figure of the North Hilo, South Hilo and Puna Districts (excludes Kapoho and Kalapana areas). The 1980 II-F projected population of 54,500 people for Hydrographic Area II reflects an increase of approximately 33 percent since 1970 (Table 3).

Water Supply

Among the five hydrographic areas on the island, Hydrographic Area II is the most abundant in water supply. This is proven by the extremely high annual rainfall of 300 inches that occurs within the South Hilo District (Figure 2). The North Hilo District receives the most varied amount of rainfall, ranging from as low as 20 inches along its northern boundary to approximately 150 inches along its coastal border. The Puna sector (district portion within Hydrographic Area II) receives an annual average of approximately 175 inches of rainfall. Hydrographic Area II receives a total rainfall of 7,335 mgd (Table 1). The combined sustainable yield (ground and surface water) within this region amounts to 2,300 mgd (Table 2).

The projected municipal demand for Hydrographic Area II, as presented in Table 4, reflects the concentration of the Department of Water Supply's major water requirements within this area. The 1980 projection of approximately 9.0 mgd represents about 64 percent of the island's total water requirements.

HYDROGRAPHIC AREA II
WATER SYSTEMS

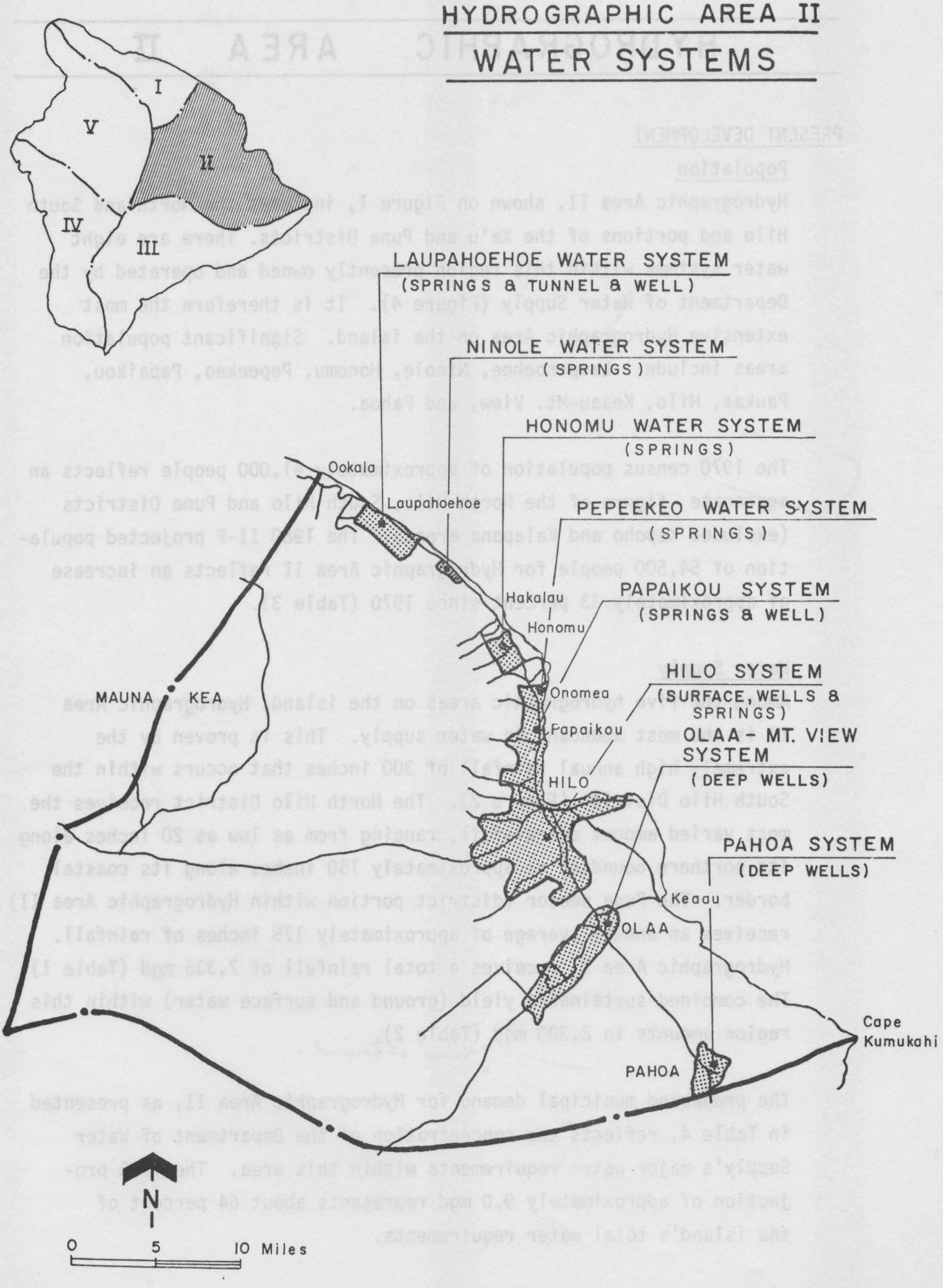


FIGURE 4

Developed Sources

The Department of Water Supply satisfies its requirements within this hydrographic region from over 20 sources, including: 10 wells, 8 springs, and 3 surface water sources. The Hilo water system is by far the most extensive and thus considered as one of the three major growth areas (the two other major growth areas are Kona and Kohala).

The capacities of existing sources within Hydrographic Area II are given as follows:

Source	Capacity (mgd)
Deep Wells	
Laupahoehoe (1)	0.20 (140 gpm - 24 hr.)
Papaikou (1)	0.54 (375 gpm - 24 hr.)
Piihonua (1)	3.02 (2100 gpm - 24 hr.)
Panaewa (2)	3.17 (2200 gpm - 24 hr.)
Olaa (2)	1.62 (1125 gpm - 24 hr.)
Keonepoko (1)	1.01 (700 gpm - 24 hr.)
Pahoa (2)	0.50 (350 gpm - 24 hr.)
Springs	
Manowaiopae	0.02 (Stearns & MacDonald)
Kihalani	0.10 (Stearns & MacDonald)
Ninole (Chaves)	0.06 (40 gpm - 24 hr.)
Akaka Falls	0.14 (Stearns & MacDonald)
Maukaloa (Makea)	0.40 (Stearns & MacDonald)
Kaieie Intake	0.02 (Stearns & MacDonald)
Papaikou Intake	0.30 (Stearns & MacDonald)
Lyman	3.00 (average flow)
Olaa Flume	5.00 (Dept. of Land & Nat. Res.)
Waiakea-Uka	0.08 (53 gpm minimum flow)
Surface	
Piihonua (Kahoama, Puka Maui, & Lauoli)	3.00 (avg. flow; Wailuku River)
TOTAL	22.18 mgd

1990 DEVELOPMENT

Population

The projected population within this planning period (1980-1990) for Hydrographic Area II of 63,500 reflects an increase of 17 percent or approximately 1.7 percent per year. The City of Hilo, considered as one of three major growth areas, will experience continued growth, with medium to large businesses encroaching into Hilo's suburbs.

Growth today is concentrated within the Waiakea-Panaewa sector, with a steady increase in housing along the upper Komohana and upper Waiakea Homestead areas. Growth is also progressing along the Hamakua coast, with housing developments assuming previous sugarcane lands.

Demand

The 1990 projected municipal demand for Hydrographic Area II is 11.8 mgd.

LAUPAHOEHOE SYSTEM

Description

The Laupahoehoe System generally obtains its water from high level springs located in the Manowaiopae and Kuwaikahi Gulches. None of these spring sources are dependable during dry weather periods. During previous dry spells, the Department has supplemented the spring supplies by diverting the Manowaiopae Stream flow into the system. The supplemental stream diversion has since been eliminated by the installation of a deep well and pump with a capacity of about 0.20 mgd.

Proposed Improvements

Developments and improvements for the Laupahoehoe System are planned as follows: (Refer to Plate 4)

- Source

  Laupahoehoe Deep Well No. 2

- Reservoir

  Waipunalei 0.1-MG Reservoir

  Kihalani 0.1-MG Reservoir

  Kihalani 0.05-MG Reservoir

- Booster Pumps

  Kihalani Booster Pump Station

- Distribution

  Laupahoehoe-Papaaloa Pipeline

NINOLE SYSTEM

Description

The Ninole System, completed in 1977, obtains its water from the Chaves Spring which is located at elevation 303 feet and situated about 700 feet above the Hawaii Belt Road. The water is pumped by two 40 gpm pumps to a 0.05-MG reservoir at elevation 511 feet. The system's present usage is about 8,000 gallons per day.

Proposed Improvements

Being a new system, no improvements are necessary at present or planned for the foreseeable future.

WAILEA-HAKALAU SYSTEM

Description

The Wailea-Hakalau System is presently only a planned system. The system will consist of a 50 gpm capacity deep well, a 46,000 gpd Hakalau-Iki Spring, two reservoirs with 0.05 MG and 0.02 MG capacities, 12,200 feet of 6-inch pipeline, 1,200 feet of 4-inch pipeline, with necessary controls, chlorination facilities and other appurtenances.

The system will serve an existing plantation community with a more dependable water system meeting applicable standards and regulations. Approximately 40 families will be served with an approximate demand of 0.05 mgd. Construction of the system, contingent on the availability of funds, is expected to occur in two phases.

HONOMU SYSTEM

Description

The Honomu System was dedicated to the Department of Water Supply by the Pepeekeo Sugar Company.

Source

The system obtains its water supply from Kolekole Stream near Akaka Falls. Pipes, varying in size from 8 to 3 inches, transport the water to Honomu Village. The 6-inch trunk line and mains are adequate to furnish the village's domestic and fire flow requirements.

Demand

The demand on this system is approximately 55,000 gpd. However, vacant lands, if developed, will result in additional usage.

Proposed Improvements

Developments and improvements planned for the Honomu System are as follows: (Refer to Plate 6)

- Reservoir
  Honomu 0.1-MG Reservoir No. 2

- Other
  Pressure regulator on Akaka Falls to Honomu transmission

PEPEEKEO WATER SYSTEM

Description

The present Pepeekeo Water System was originally owned by the Pepeekeo Sugar Company. The source of supply was the overflow from the separate plantation system. In 1938, the County acquired the Pepeekeo Water System under the stipulation that the sugar company would not guarantee the County any given quantity from the overflow. This provision has caused many problems in the past as the overflow has not been sufficient at times. The Department of Water Supply has therefore acquired water rights for Maukaloa Springs to curtail inadequate supply problems experienced in the past.

Source

Maukaloa Springs, or Makea Springs as listed in the publication by Stearns and MacDonald, in the Alia Stream is the source for this system. The daily discharge is about 0.4 mgd (there is no minimum flow record).

The water supply is transported by an 8-inch pipe to a reservoir at about the 834-foot elevation.

Demand

The service area of the County system consists mostly of the Kulaimano Heights Subdivision constructed incrementally since 1966. In 1971 the usage was 40,000 gpd. Today, because of the subdivision, the usage is 97,000 gpd. There are presently 500 of the 700 units ultimately planned for the subdivision. The development is composed of residential, apartment, and commercial units.

Proposed Improvements

Developments and improvements for the Pepeekeo System are planned as follows: (Refer to Plate 6)

- Source
  Pepeekeo Deep Well Development

- Transmission
  Pepeekeo to Papaikou Transmission System

- Distribution
  Various pipeline improvements within existing system

PAPAIKOU WATER SYSTEM

The Papaikou Water System serves Papaikou, Paukaa, Puueopaku and Kalaoa. Recent improvements included the connection of this system to the Paukaa-Hilo Systems.

Source

This system is served by the Kaieie and Papaikou Intakes, which are perched spring water sources and a deep well located above Papaikou Town. From Stearns and MacDonald, daily discharges are 0.02 mgd and 0.30 mgd, respectively, for Kaieie and Papaikou.

Papaikou Intake goes dry frequently and in comparing the two spring sources, the Kaieie supply seems to be the most stable (the Papaikou Intake dries frequently).

The Papaikou Deep Well has a pumping capacity of 0.54 mgd based on a 375 gpm pump operating 24 hours per day.

Demand

The present average consumption is 251,000 gpd. The usage is not expected to increase significantly.

Proposed Improvements

Developments and improvements for the Papaikou System are planned as follows: (Refer to Plate 7)

- Source
  Papaikou Deep Well No. 2

- Storage
  Kaieie Mauka 0.05-MG Reservoir

- Booster Pump
  Kaieie Mauka Booster Stations

- Transmission
  Kaieie Mauka Transmission - 8,000'

- Distribution
  Various pipeline improvements within existing system

- Other
  Supervisory control at Papaikou Well
  Master meter installation

HILO WATER SYSTEM

Description

The Hilo Water System, considered the most extensive of all public water systems on the island, is shown on Plate 8. The system has been extended north along the Hamakua Coast to Papaikou by the linking of the Paukaa System with both the Hilo and Papaikou Systems (See Plate 7). The major service areas are the City's commercial and industrial areas and residential areas of Keaukaha, Kaumana, Waiakea Houselots, Waiakea Homestead, Waiakea Uka and Panaewa.

Sources

This system is supplied with the following surface and groundwater sources:

- Piihonua Source

  This surface water source is composed of the Kahoama, Puka Maui and Lauoli Intakes.

  During normal operations, the Kahoama and Puka Maui Intakes provide water of adequate quality. During heavy rains, however, the Puka Maui Intake supply is discontinued due to high turbidity (the Kahoama Intake also experiences turbidity problems but is maintained as it is the primary intake). The conditional nature of the intakes requires constant surveillance which at times is not possible. Lauoli Intake is used only during extreme low flow periods.

  U. S. Geological Survey records show that the average flow of Wailuku River at gaging station 7040 is 178 mgd. The minimum flow, however, is far less, as was observed in 1963 when flows were less than 1.0 mgd (40-day period).

- Lyman Spring

  Water from this source is bought from Orlando Lyman under a new 7-year agreement which began in April 1980. This new agreement has yet to be consumated. The previous expired lease began in 1950. The average flow from this spring is about 3 mgd which is significantly higher than the Department of Water Supply's use (about 270,000 gallons per day). During the 1962-1963 drought, the low flow at this spring was about 1.2 mgd.

  The spring source, located at an elevation of approximately 1,630 feet feeds the 4- and 5-mile Kaumana areas. It also serves as a supplement to the Piihonua source which services the "lower" City of Hilo area.

- Olaa Flume Source

  Development of this source was completed in 1978. The source, located at elevation 1,975 feet, feeds the 0.30 MG reservoir located at elevation 1,909 feet. The source flow capacity ranges from a low of less than 1.0 mgd to a high of about 11.0 mgd depending on climatic conditions. The transmission line is designed for a capacity of 5.0 mgd and is expected to flow at this rate about 65 percent of the time. The present requirements from this source is about 0.10 mgd. Although consumption is limited to the upper Kaumana area, the Olaa Flume Phase II Development will increase the service area to encompass Piihonua and other areas of the City of Hilo.

- Waiakea-Uka Spring

  The Department presently uses about 0.7 mgd from this source. There is no record of the overflow which therefore precludes any estimate on its capacity. The flow varies greatly with weather changes from

need to determine overflow (are)

almost dry conditions to an abundant supply during heavy rains. During the February-March 1970 drought, the flow dropped as low as 0.05 mgd. Despite the inconsistent nature of flow, the quality of this spring supply is usually excellent.

- Panaewa Well

  Water from this source is pumped from the basal aquifer with two pumps of 2.0 mgd and 3.0 mgd capacity. Presently, about 4.2 mgd is used from this source. The supply, which is pumped to the Puainako Reservoir (elevation 290 feet), is combined with the Reservoir No. 3 supply to accommodate the lower service level of Hilo (elevation 0 to 200± feet). Water is also pumped to the Haihai and Kawailani Reservoirs at elevations 464 feet and 456 feet, respectively.

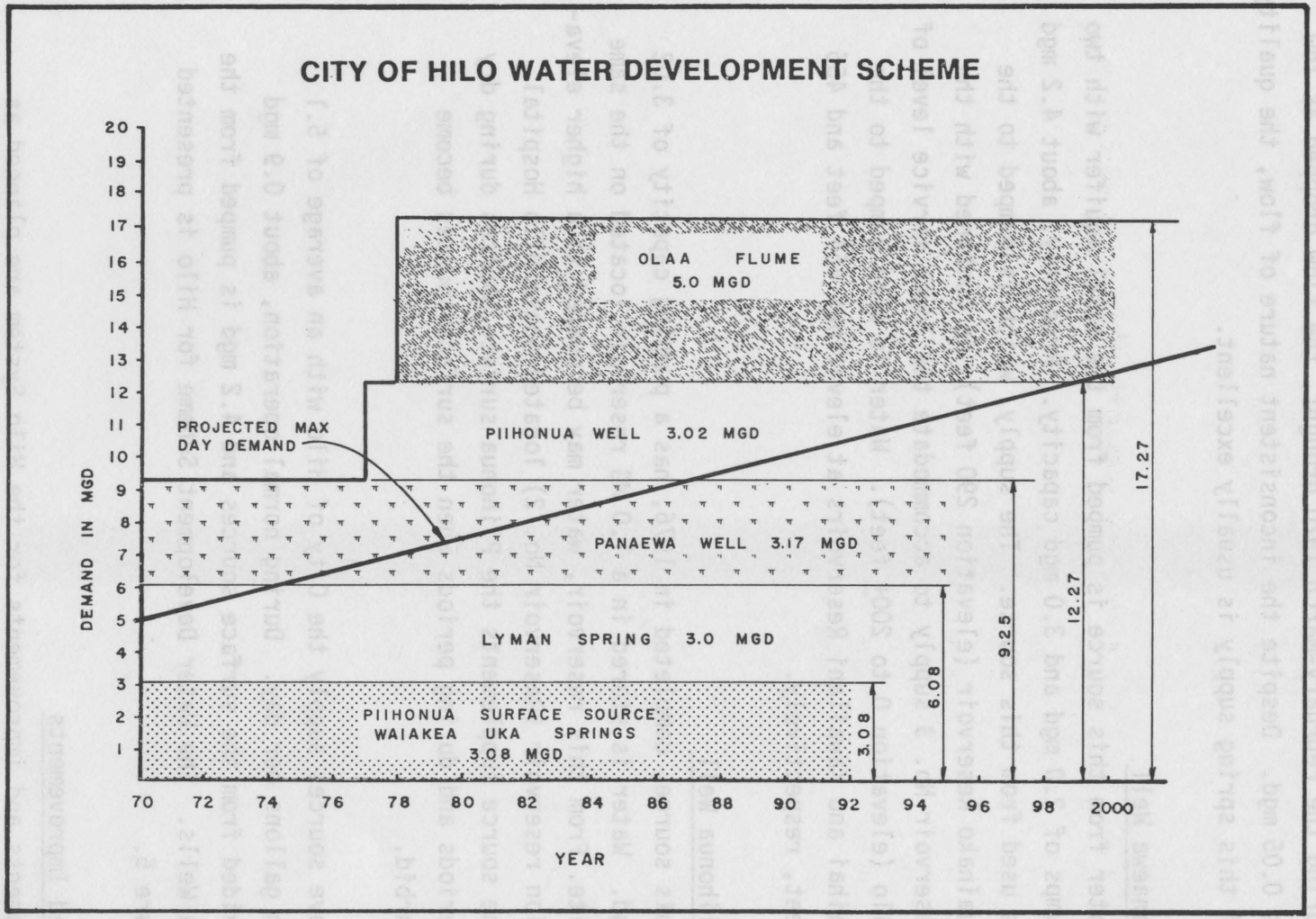
- Piihonua Well

  This source, completed in 1976, has a pumping capacity of 3.02 mgd. Water is stored in a 1.0 MG reservoir located on the same site. From this reservoir, water may be pumped to a higher elevation reservoir (Reservoir No. 2) located above Hilo Hospital. The source supplements the Piihonua surface sources during dry periods and during periods when the surface sources become turbid.

The above sources supply the City of Hilo with an average of 5.1 million gallons per day. During normal operation, about 0.9 mgd is provided from the surface sources and 4.2 mgd is pumped from the Panaewa Wells. The Water Development Scheme for Hilo is presented on Figure 5.

Proposed Improvements

Developments and improvements for the Hilo System are planned as follows: (Refer to Plate 8)


CITY OF HILO WATER DEVELOPMENT SCHEME
DEMAND IN MGD
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5
4
3
2
1
OLAA FLUME
5.0 MGD
PROJECTED MAX
DAY DEMAND
PIIHONUA WELL 3.02 MGD
PANAEWA WELL 3.17 MGD
LYMAN SPRING 3.0 MGD
PIIHONUA SURFACE SOURCE
WAIAKEA UKA SPRINGS
3.08 MGD
3.08
6.08
9.25
12.27
17.27
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72
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2000
YEAR

FIGURE 5

- Source

  Panaewa Deep Well No. 3 to supplement existing wells

  Piihonua Deep Well No. 2 to supplement existing well

  Olaa Flume-Waiakea-Mt. View source and transmission

- Reservoir

  Chongmansville 0.50-MG Reservoir

  Haihai 0.50-MG Reservoir

  New Camp 7 0.5-MG Reservoir

  Kaumana 0.3-MG Reservoir No. 1

  Kaumana 0.1-MG Reservoir No. 2

  Piihonua 0.5-MG Reservoir No. 2

  De Lima 0.3-MG Reservoir

  Kawailani 0.5-MG Reservoir

- Distribution

  Various pipeline improvements within the existing water system

- Transmission

  Kaumana to Waiakea Uka (New Camp 7) - 11,000'

  Hoaka Road - New Camp 7 to Camp 6 - 8,000'

  Kaumana Drive to Kawailani Street - 8,000'

  Chong Reservoir to Puainako Reservoir - 11,000'

  Ainako to Komohana - 7,000'

  Ponahawai to Kupulau - 13,000'

  Mohouli to Kawailani - 6,000'

- Booster Pumps

  Panaewa Booster No. 2

  Piihonua Reservoir No. 3, Booster No. 2

  Waiakea Reservoir Booster

  Puainako Booster

  Camp 6 Booster additions

  Haihai Booster additions

  Existing Camp 7 Booster

  New Camp 7 Booster

- Other

  Engineering-Fiscal Complex at Department of Water Supply Operations Center

  Laboratory Complex at Department of Water Supply Operations Center

  Master Meter installations

  Access road improvements

OLAA-MT. VIEW WATER SYSTEM

Description

The Olaa-Mt. View Water System consists of eight service areas with a total of ten storage tanks and seven booster stations.

Source

Water for this system is supplied by two deep wells (750 gpm and 1125 gpm) located at the Puna Sugar Mill. Located in the vicinity of the County wells are three Puna Sugar Company wells. These three wells, each having a pump capacity of 2,800 gpm, produce about 11 mgd for sugar-cane processing and for power plant operations. Adequate groundwater recharge measures have been taken to prevent overdraft of the basal aquifer.

Basal groundwater underlies the eastern slopes of Kilauea and Mauna Loa, with the possible exception of the East Rift Zone of Kilauea where water is probably impounded by dikes at a higher level. The elevation of the freshwater table at the Puna Sugar Mill (3.5 miles inland from the coast) is about 17 feet above sea level. This indicates an average water table gradient of about five feet per mile.

Throughout the area from Hilo to the East Rift Zone of Kilauea, high rainfall provides substantial groundwater recharge. Also, due to the region's geological structure, groundwater circulation is rapid. The water is thus subject to considerable filtration which naturally eliminates bacterial contamination. Chloride tests have indicated a low salt content of only 9 ppm. In general, the groundwater source provides water of good quantity and quality.

A listing of demand versus pump capacity is given in Tables 5 and 6.

Proposed Improvements

Developments and improvements for the Olaa-Mt. View System are planned as follows: (Refer to Plate 9)

- Source

  Waiakea (South Hilo) to Mt. View source and transmission

  Glenwood surface source and treatment

- Transmission

  12-inch transmission from Keaau to Station No. 3

- Reservoirs

  Improve existing steel tanks with epoxy lining

- Distribution

  Various pipeline improvement projects within the existing system

- Other

  Telemetering system for Stations 3 and 7 to provide a monitoring and alarming system

  Master meter installation at strategic locations to monitor consumption

PAHOA WATER SYSTEM

Description

The existing water system includes a 0.30-MG and a 0.50-MG concrete reservoir, a 12-inch deep well with a 700 gpm pump (Keonepoko Nui Deep Well), a 12-inch deep well with a 350 gpm pump, and an 8-inch deep well with a 250 gpm pump (Pahoa Deep Wells).

Source

Groundwater is abundant in the area of the Pahoa Wells. The high permeability of the surface lavas, evidenced by a total absence of runoff results in a high groundwater recharge rate. Besides insuring

TABLE 5

DEMAND VS. PUMP CAPACITY
OLAA-MT. VIEW

	Present Consumption		2000 Projected Consumption	
(545)	1980 Ave. Day	Max. Day + Losses	Ave. Day	Max Day + Losses
Peck Road Usage (185)	.010	.020	0.022	0.044
Peck Road Booster	3 - 50 gpm pumps Safe Capacity = 0.072 Normal " = 0.048			
Volcano Tank Usage (190)	.013	.026	0.024	0.047
	.023	.046	0.046	.091
Station #7	3 - 70 gpm pumps Safe Capacity = .105 Normal " = .070			
Usage from #7 Reservoir (180)	.072	.144	.240	.480
	.095	.190	.286	.571
Station #6	1 - 225 gpm pump 2 - 200 gpm pumps Safe Capacity = .372 Normal " = .248			
PPG	2 - 200 gpm pumps Safe Capacity = .288 Normal " = .193		Change Pipeline	
Usage to PPG (175)	.009	.018	.028	.056
Usage from #6 Reservoir (165)	.017	.034	.053	.106
	.121	.242	.367	.733
Station #5	3 - 225 gpm pumps Safe Capacity = .333 Normal " = .222		Change Pipeline	
Usage from #5 (160)	.010	.020	.02	.04
	.131	.262	.387	.773

Safe capacity based on pump(s) running 24 hours/day - should be greater than maximum day consumption.

Normal Capacity based on pump(s) running 16 hours/day - should be greater than average day consumption.

Pump capacity based on system curves.

TABLE 6

DEMAND VS PUMP CAPACITY
OLAA-MT. VIEW

	Present Consumption		2000 Projected Consumption	
	1980 Ave. Day	Max. Day + Losses	Ave. Day	Max Day + Losses
	.131	.262	.387	.773
Station #4	1 - 225 gpm pump 2 - 220 gpm pumps Safe Capacity = .357 Normal " = .238		Change Pipeline	
Usage from #4 (150)	.066	.132	.196	.391
	.197	.394	.583	1.164
Station #3	3 - 333 gpm pumps Safe Capacity = .510 Normal " = .340		Change Pipeline	
Usage from #3 (140)	.186	.372	.396	.792
	.383	.766	.979	1.956
Station #2	4 - 520 gpm pumps Safe Capacity = .792 Normal " = .528		Change Pipeline	
Usage from #2 (135)	.084	.168	.190	.380
	.467	.934	1.169	2.336
Station #1	Olaa Deep Well Safe Capacity = 0.72 Normal " = 0.60		Drill Well	

a thick freshwater lens, subsurface circulation of groundwater produces a supply of excellent quality. Assuming a 24-hour pumping duration, the combined capacity of the Pahoa Wells is about 0.9 mgd. The Keonepoko deep well contributes an additional 1.0 mgd.

Demand

The present water demand on the existing system is approximately 152,000 gpd.

Proposed Improvements

Developments and improvements for the Pahoa System are planned as follows: (Refer to Plate 10)

- Source

  Additional Deep Well to supplement existing Keonepoko Nui Well
  Additional Deep Well or higher capacity pumps at existing Pahoa Well

- Reservoir

  Keonepoko Iki 0.30-MG Reservoir, Elevation 720'±
  Pohoiki 0.50-MG Reservoir, Elevation 720'±

- Transmission

  Keaau-Pahoa Trunk Line, Phase III

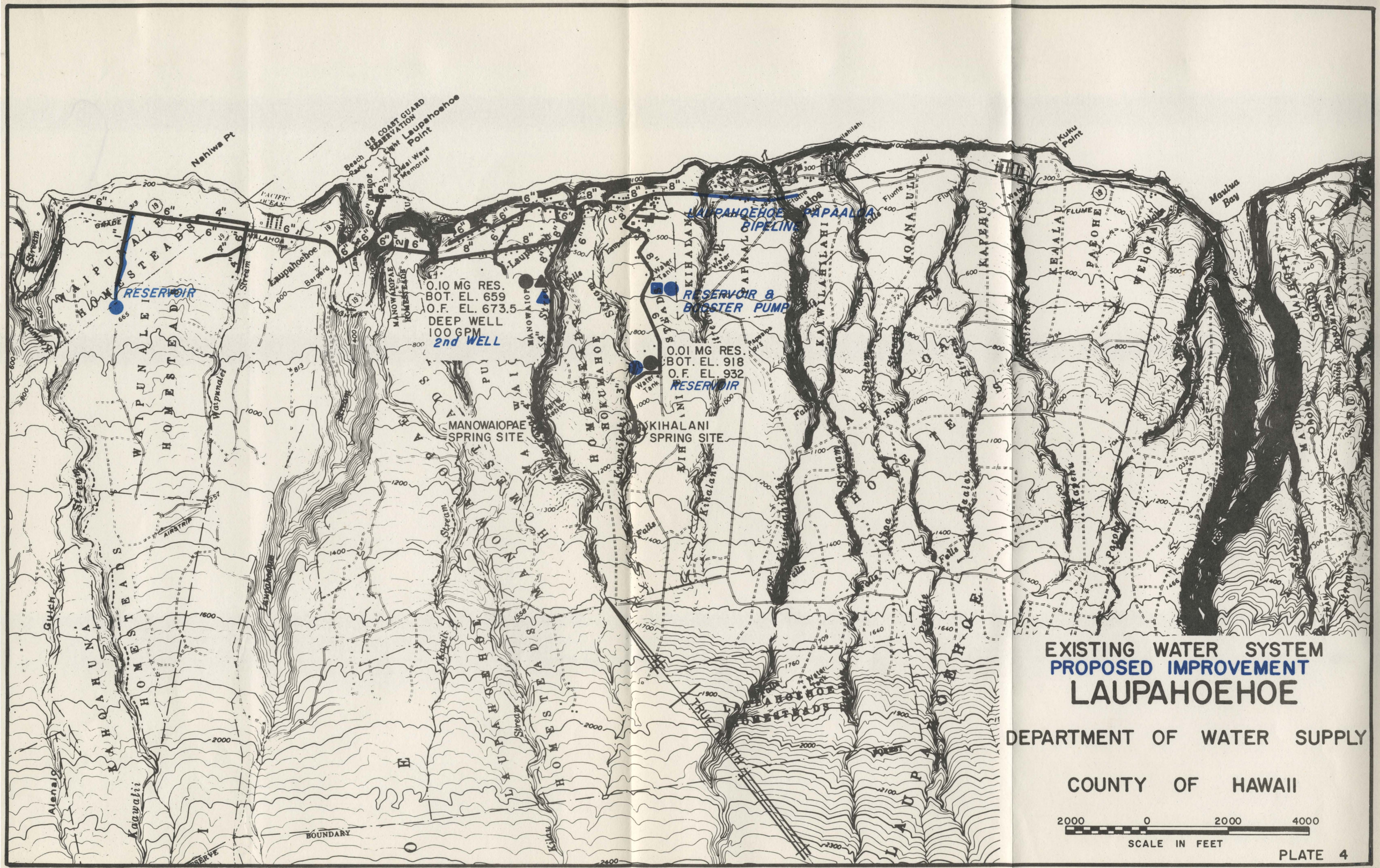
  Pahoa Bypass Waterline; in conjunction with Department of Transportation's Pahoa Bypass Road

- Distribution

  Various pipeline improvement projects within the existing system

- Other

  Master meter installation at strategic locations to monitor consumption



EXISTING WATER SYSTEM
PROPOSED IMPROVEMENT

LAUPAHOEHOE

DEPARTMENT OF WATER SUPPLY

COUNTY OF HAWAII

2000 0 2000 4000
SCALE IN FEET

PLATE 4

PUMP (2-40 GPM)
EL. 297
CHAVES INTAKE
(SPRING)
0.05 MG RESERVOIR
O.F. ELEV. 525.50
BOT. ELEV. 511.00

EXISTING WATER SYSTEM
NINOLE
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII

NORTH

1000 0 1000 2000
SCALE IN FEET

PLATE 5

TRUE NORTH

PIPELINE

WELL

WAILEA-HAKALAU
EXPLORATORY WELL
ELEV. 235

0.05MG RESERVOIR

TRANSMISSION

0.10 MG RES.
BOT. EL. 524.50
O.F. EL. 539.50
2nd RESERVOIR

PRV. STATION
PRESSURE BREAKER
ELEV. 997

0.30MG RES.
BOT. EL. 834
O.F. EL. 849

PEPEEKEO
SPRING SITE

0.30 MG RES.
BOT. EL. 691.5
O.F. EL. 707

KULAIMANO
EXPLORATORY WELL
ELEV. 375

PIPELINE

TRANSMISSION

0.05MG RESERVOIR

HAKALAU IKI SPRING

EXISTING WATER SYSTEM
HAKALAU
HONOMU-PEPEEKEO
PROPOSED IMPROVEMENT
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII

2000 0 2000 4000
SCALE IN FEET

PLATE 6

PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
PAUKAA-PAPAIKOU
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII

NORTH

2000 0 2000 4000

SCALE IN FEET

0.02 MG RES.
EL. 1552.25

BOOSTER PUMP
70 GPM

0.02 MG RES.
EL. 1118.75

PAPAIKOU INTAKE

0.005 MG RES.
EL. 1234.17

0.02 MG
EL. 1153.30

BOOSTER PUMP
32 GPM

TRANSMISSION

RESERVOIR &
BOOSTER PUMP

KAIEIE INTAKE

BOOSTER PUMP
70 GPM

0.10 MG RES.
EL. 662.50

BOOSTER PUMP
150 GPM

0.10 MG RES.
EL. 335.50

MASTER METER

HAAHEO
BOOSTER PUMP
150 GPM

BOOSTER PUMP

0.10 MG RES.
EL. 555±

0.024 MG RES.
EL. 592±

0.25 MG RES.
O.F. EL. 461
BOT. EL. 445

DEEP WELL
350 GPM
EL. 370±

2nd WELL
SUPERVISORY
CONTROL

MASTER METER

PIPELINE

PIPELINE

PLATE 7

0.05 MG RES.
BOT. EL. 1286
O.F. EL. 1304

0.02 MG RES.
BOT. EL. 1051.50
O. F. EL. 1069.50
BOOSTER
1-100 GPM

WELL NO. 2
BOOSTER PUMP
1.00 MG RES.
BOT. EL. 280
O.F. EL. 300
DEEPWELL
2100 GPM
BOOSTEP
1-1500 GPM

0.30 MG RES.
BOT. EL. 1198
O.F. EL. 1213

OLAA FLUME
SPRING SITE

LYMAN SPRING
SITE

1.00 MG RES.
BOT. EL. 977
O.F. EL. 997

0.80 MG RES.
BOT. EL. 986
O.F. EL. 1000

0.80 MG RES.
BOT. EL. 632
O.F. EL. 646
RESERVOIR

0.10 MG RES.
BOT. EL. 1570
O.F. EL. 1584.5

0.10 MG RES.
BOT. EL. 707
O.F. EL. 721
TRANSMISSION

0.30 MG RES.
BOT. EL. 1909
O.F. EL. 1924

RESERVOIR
0.05 MG RES.
BOT. EL. 1312
O.F. EL. 1332.50

0.10 MG RES.
BOT. EL. 709
O.F. EL. 724

0.02 MG RES.
BOT. EL. 1475
O.F. EL. 1487
BOOSTER
2-70 GPM

0.10 MG RES.
BOT. EL. 1795
O.F. EL. 1809

TRANSMISSION

0.05 MG RES.
BOT. EL. 1008
O.F. EL. 1028.50
RESERVOIR

RESERVOIR

1.00 MG RES.
BOT. EL. 270
O.F. EL. 290

0.50 MG RES.
BOT. E/L 337
O.F. EL. 354

TRANSMISSION

BOOSTER PUMP

0.30 MG RES.
BOT. EL. 1318
O.F. EL. 1333

RESERVOIR

PIPELINE

0.50 MG RES.
BOT. EL. 456
O.F. EL. 479

BOOSTER PUMP
RESERVOIR

BOOSTER PUMP

0.10 MG RES.
BOT. EL. 845.02
O.F. EL. 867.32

PIPELINE

RESERVOIR
0.05 MG RES.
BOT. EL. 1307
O.F. EL. 1323

WAIAKEA - OLAA
FLUME DEVELOPMENT

WAIAKEA-UKA
SPRING SITE

TRANSMISSION

0.50 MG RES.
BOT. EL. 638
O.F. EL. 656
BOOSTER
2-300 GPM

BOOSTER PUMP

0.10 MG RES.
BOT. EL. 464.60
O.F. EL 478.98
BOOSTER
2-500 GPM

BOOSTER PUMP
RESERVOIR

0.05 MG RES.
BOT. EL. 399
O.F. EL. 413

PANAEWA WELL NO.1
EL. 206.60
1500 GPM
PANAEWA WELL NO.2
EL. 201.50
2200 GPM
BOOSTER-1-1500 GPM

WELL NO. 3
BOOSTER PUMP

ENGINEERING
FISCAL COMPLEX

LABORATORY

HILO BAY

BLONDE REEF

PACIFIC OCEAN

Kuhio Bay

Puhi Bay

Keaukaha

Hawaii National Guard

TRUE NORTH

PUNAHOA 1

ONAHAWAI HOMESTEADS

KUKUAU

WAIAKEA

WAIAKEA HOMESTEADS

PANAEWA FOREST RESERVE

SOUTH HILO DISTRICT
PUNA DISTRICT

PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM

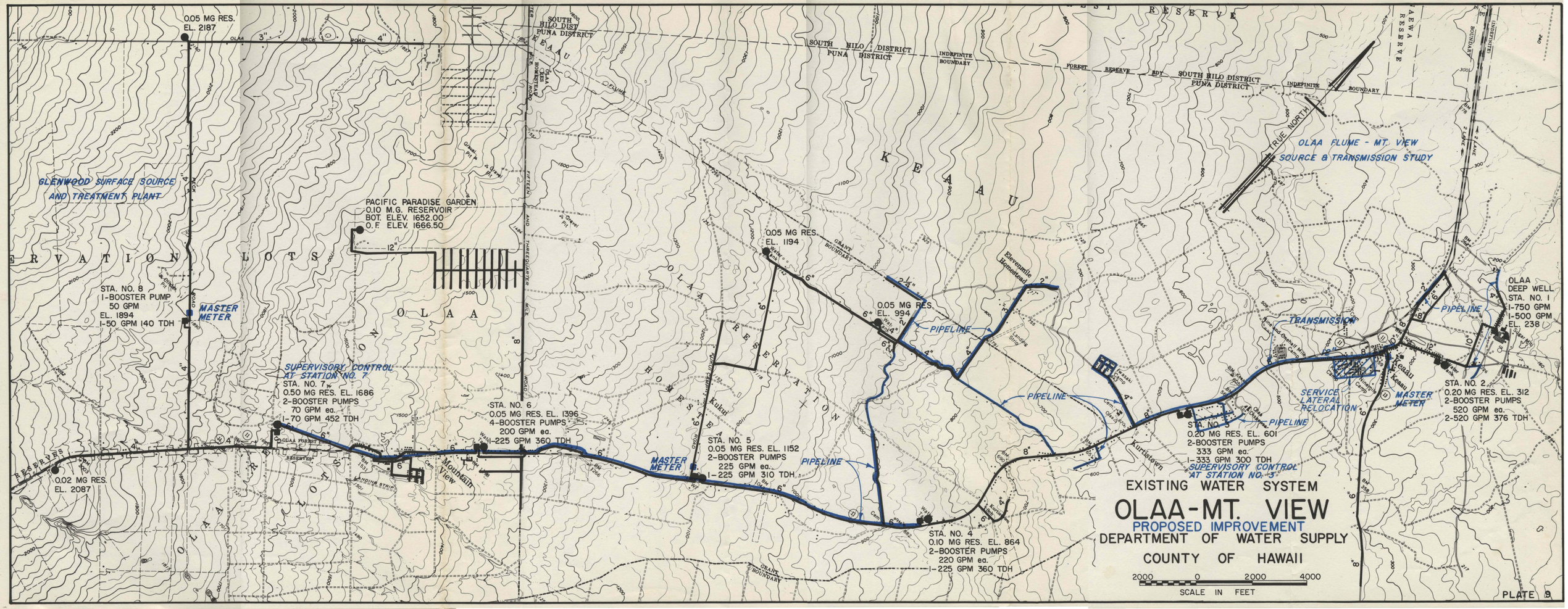
CITY OF HILO

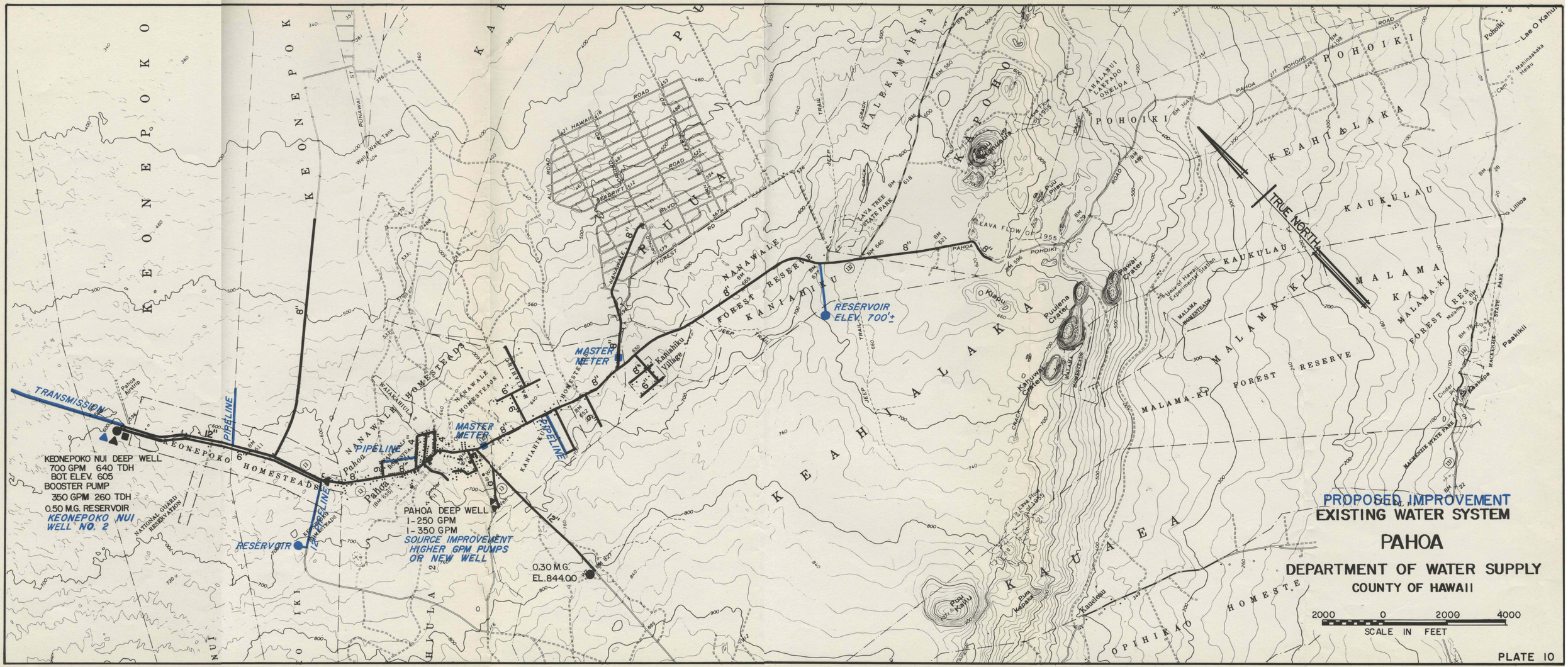
DEPARTMENT OF WATER SUPPLY

COUNTY OF HAWAII

2000 0 2000 4000
SCALE IN FEET

PLATE 8


0.05 MG RES.
EL. 2187
GLENWOOD SURFACE SOURCE
AND TREATMENT PLANT
PACIFIC PARADISE GARDEN
0.10 M.G. RESERVOIR
BOT. ELEV. 1652.00
O.F. ELEV. 1666.50
STA. NO. 8
1-BOOSTER PUMP
50 GPM
EL. 1894
1-50 GPM 140 TDH
MASTER METER
SUPERVISORY CONTROL AT STATION NO. 7
STA. NO. 7
0.50 MG RES. EL. 1686
2-BOOSTER PUMPS
70 GPM ea.
1-70 GPM 452 TDH
0.02 MG RES.
EL. 2087
STA. NO. 6
0.05 MG RES. EL. 1396
4-BOOSTER PUMPS
200 GPM ea.
1-225 GPM 360 TDH
0.05 MG RES.
EL. 1194
0.05 MG RES.
EL. 994
STA. NO. 5
0.05 MG RES. EL. 1152
2-BOOSTER PUMPS
225 GPM ea.
1-225 GPM 310 TDH
STA. NO. 4
0.10 MG RES. EL. 864
2-BOOSTER PUMPS
220 GPM ea.
1-225 GPM 360 TDH
STA. NO. 3
0.20 MG RES. EL. 601
2-BOOSTER PUMPS
333 GPM ea.
1-333 GPM 300 TDH
SUPERVISORY CONTROL AT STATION NO. 3
OLAA DEEP WELL
STA. NO. 1
1-750 GPM
1-500 GPM
EL. 238
STA. NO. 2
0.20 MG RES. EL. 312
2-BOOSTER PUMPS
520 GPM ea.
2-520 GPM 376 TDH
PIPELINE
TRANSMISSION
SERVICE LATERAL RELOCATION
OLAA FLUME - MT. VIEW
SOURCE & TRANSMISSION STUDY
EXISTING WATER SYSTEM
OLAA-MT. VIEW
PROPOSED IMPROVEMENT
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE 8


KEONEPOKO NUI DEEP WELL
700 GPM 640 TDH
BOT. ELEV. 605
BOOSTER PUMP
350 GPM 260 TDH
0.50 M.G. RESERVOIR
KEONEPOKO NUI
WELL NO. 2
TRANSMISSION PIPELINE
KEONEPOKO HOMESTEADS
RESERVOIR
PIPELINE
NANAWALE HOMESTEADS
MASTER METER
PAHOA DEEP WELL
1-250 GPM
1-350 GPM
SOURCE IMPROVEMENT
HIGHER GPM PUMPS
OR NEW WELL
0.30 M.G.
EL. 844.00
KANIAHIKU VILLAGE
RESERVOIR
ELEV. 700'±
NANAWALE FOREST RESERVE
KAPOHO
KEAHIALAKA
KAUKULAU
MALAMA-KI FOREST RESERVE
POHOIKI
LAVA FLOW OF 1955
TRUE NORTH
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
PAHOA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE 10

HYDROGRAPHIC AREA III

PRESENT DEVELOPMENT

Population

Hydrographic Area III is situated along the southeastern slopes of Mauna Loa and extends along the southeastern coastline of the island (Figure 1). This region contains the largest district of Ka'u (portions excluded) as well as the southern portion of the Puna District. There are five independent water systems presently serving the area (Figure 6). The populated areas include: Kapoho, Kalapana, Pahala and Naalehu.

Hydrographic Area III remains as one of the least populated regions on the island. A large percentage of the total land area is occupied by the National Forest Reserve in addition to the extensive lava fields as a result of past volcanic activity. The estimated 1980 population for Hydrographic Area III is approximately 4,300 people (Table 3).

Areas expected to grow, if at all, are Kapoho and Kalapana in the Puna District and Pahala, Punaluu and Naalehu in the Ka'u District. The Discovery Harbors Development is another growing area in Hydrographic Area III (Naalehu-Waiohinu).

Water Supply

The highest annual rainfall of Hydrographic Area III of approximately 150 inches occurs along the border of Hydrographic Areas II and III as illustrated in Figure 2. A low of 15 inches is prevalent at the summit of Mauna Loa. Generally, precipitation is least along the shore and near the summit of Mauna Loa. The greatest amounts occur at an altitude of about 3,000 feet on Mauna Loa above Pahala (100-125 inches). The mean at the summit of Kilauea (elevation 4,000 feet) is 80-100 inches. The total rainfall within this hydrographic area is approximately 2,340 mgd (Table 1).

HYDROGRAPHIC AREA III
WATER SYSTEMS

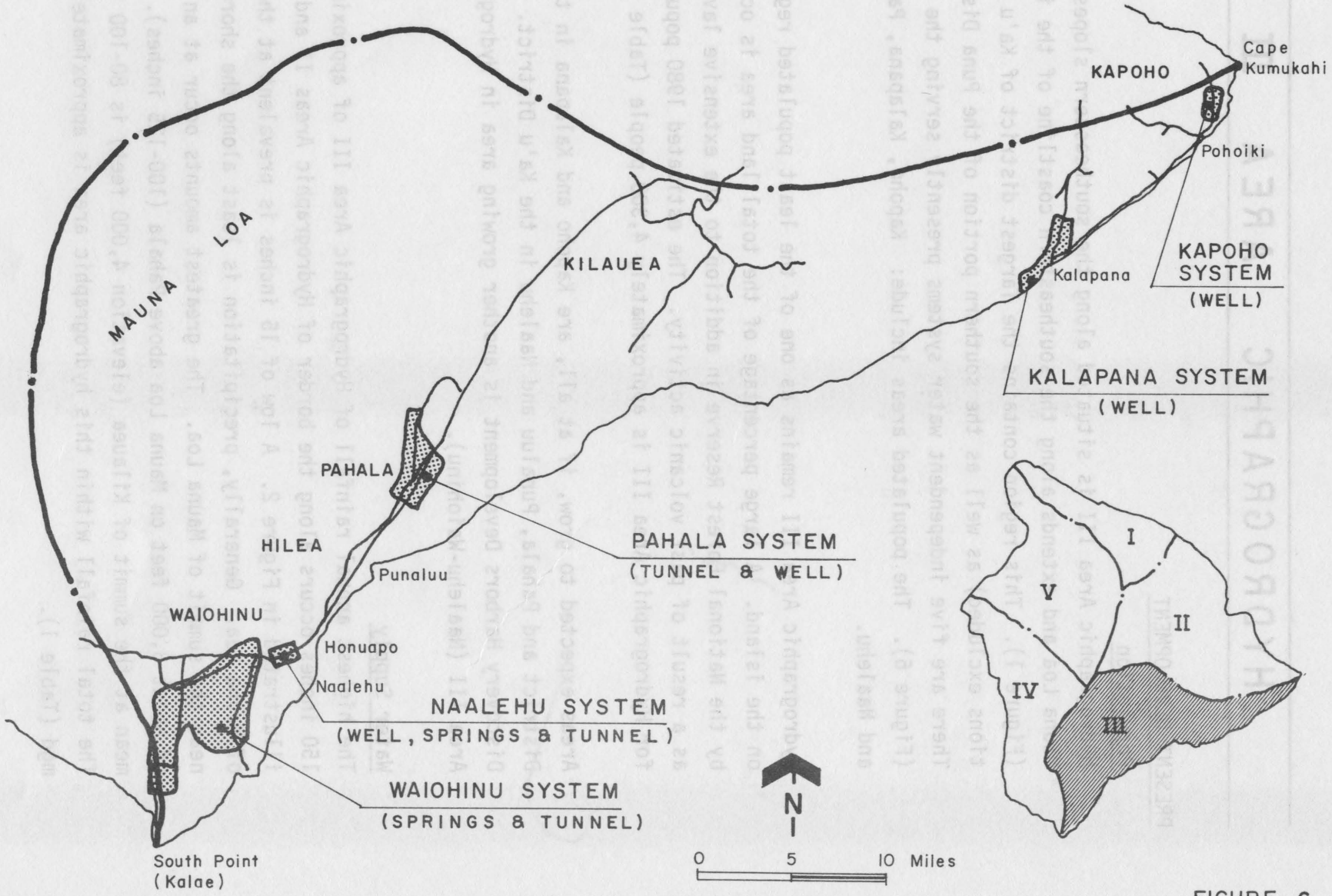


FIGURE 6

Although rainfall is abundant above Pahala and near the summit of Kilauea, stream yields are minimal due to the quick percolation of flows into the highly permeable lava. From Table 2, it is seen that the estimated sustainable yield of 110 mgd is confined to groundwater sources.

The 1980 projected demand is approximately 0.7 mgd. The water requirements have since been met by groundwater sources alone.

Developed Sources

The sources providing water requirements within Hydrographic Area III include: 5 wells, a spring source, and 2 tunnel sources. The source capacities are as follows:

Source	Capacity (mgd)
Kalapana Wells	0.50 (350 gpm pump; 24 hr)
Kapoho Well	0.14 (100 gpm; 24 hr)
Pahala Well	0.43 (300 gpm; 24 hr)
Naalehu Well	0.54 (375 gpm; 24 hr)
Haao Springs	0.60 (ave. flow; Stearns & MacDonald)
Mountain House Tunnel Spring	1.20 (ave. flow; Stearns & MacDonald)
Alili Tunnel	0.75 (ave. flow)
TOTAL	4.16 mgd

1990 DEVELOPMENT

Population

The 1990 projected population for Hydrographic Area III is 9,300 people. Although this region is one of the least populated areas, the growth rate of 12 percent per year indicates a fair amount of growth. However, deterrent to the growth potential of Hydrographic Area III is the volcanic and geologic activities presently occurring within this region. Sections of the Kalapana coast were recently altered due to land shifting caused by geologic activity. It is therefore difficult to predict the future growth behavior of this region.

Demand

The 1990 projected municipal demand for Hydrographic Area III is 1.7 mgd.

KAPOHO WATER SYSTEM

Description

The existing Kapoho Water System consists of a 100,000-gallon concrete reservoir, 3,200 lineal feet of 12-inch pipe, 6,925 lineal feet of 10-inch pipe, 20 lineal feet of 8-inch pipe, and a well (infiltration gallery) with two 100 gpm pumps.

Source

An analysis of the pumping test data of February 26-28, 1968, indicates that the safe yield of the Kapoho Well is 208 gpm or 288,000 gpd. This low estimated safe yield is due to the low permeability of the aquifer which caused a gradual increase in drawdown during the pumping test.

Geologically, the Kapoho Well produces groundwater from low to moderately permeable consolidated ash and pumice formations at the eastern edge of the Kapoho Cone. The primary groundwater recharge mechanism is thought to be rainfall within the Kapoho Cone. An average rainfall of 1.0 mgd has been estimated, however, only 30 percent or 230 gpm can be reasonably assumed as recharge to the aquifer and available for withdrawal by the Kapoho Well.

Demand

The present consumption is approximately 17,000 gpd. This low average is due to areal and climatic conditions which are ideal for agriculture. Because of favorable conditions, irrigation is kept to a minimum.

Proposed Improvements

There are no improvements planned for this area within this planning period.

KALAPANA WATER SYSTEM

Description

The Kalapana Water System consists of a 0.10-MG concrete reservoir, a 0.50-MG concrete reservoir, 44,400 lineal feet of 8-inch ductile iron pipe, 400 lineal feet of 6-inch ductile iron pipe, an 8-inch deep well with a 200 gpm submersible pump and a 12-inch deep well with a 350 gpm line shaft pump.

Source

The Kalapana Wells are located immediately south of the East Rift Zone in the Keauohana Forest Reserve. Geologically, dikes or other intrusive bodies in the East Rift Zone of Kilauea form a barrier preventing the southward movement of groundwater from the area of high rainfall (north of the rift zone and west of Hilo). The narrow land area in combination with low rainfall results in limited groundwater recharge along the southeast shore.

The quality of the groundwater along the southeast shores is usually brackish or saline, indicating the occurrence of saltwater intrusion. Although salinity decreases with distance inland, the change has been found to be irregular. As a result, large supplies of water suitable for development are probably not available from basal aquifer south of the Kilauea Rift Zone. However, it is possible to obtain supplemental amounts by utilizing low production wells.

Available well records suggest that the best location of a deep well development (south of the Kilauea Rift Zone) is northeast of Kalapana in the Keauohana Forest Reserve. The Kalapana Water System's 12-inch well, during four days of pumping at 300 gpm, discharged water containing about 90 ppm of chloride. The 8-inch well taps into the same basal aquifer.

Demand

The present demand for the Kalapana area is approximately 25,000 gpd.

Proposed Improvements

Developments and improvements for the Kalapana System are planned as follows: (Refer to Plate 12)

- Source
  Additional Deep Well to supplement the existing Keauohana Deep Well

- Reservoir
  Additional storage in the Kahaualea area

- Distribution
  Kalapana Water System Improvement, Phase IV: 3000' from Kaimu to Makena Homesteads

PAHALA SYSTEM

Description

The Pahala System serves the village of Pahala. The town consists mostly of residential homes, several commercial areas, Pahala School, and Pahala Hospital.

Source

Water for this system is obtained from Alili Tunnel and from a deep well source. The average recorded tunnel flow is 0.75 mgd. The minimum recorded flow of 0.05 mgd is less than the present demand on the system. The well source provides an additional 0.43 mgd (300 gpm, 24-hour pumpage).

The tunnel water supply is transported from Alili Tunnel to Pahala by 10-inch, 8-inch and 4-inch mains and through a series of pressure breaker tanks. The well, located just above the town, is also linked to the transmission system. The capacity of this transmission system is 0.45 mgd.

Demand

The present consumption for the Pahala area is about 412,000 gpd.

Proposed Improvements

Developments and improvements for the Pahala System are planned as follows: (Refer to Plate 13)

- Source
  Pahala Deep Well No. 2

- Treatment
  Pahala surface water treatment study
  Relocation of chlorinator station

- Reservoir
  Replace redwood pressure breaker tanks
  Epoxy line existing steel tanks

- Distribution

  Various pipeline improvements within system

WAIOHINU-NAALEHU-SOUTH POINT SYSTEMS

Source

The sources supplying Waiohinu, Naalehu and South Point include Haao Springs, the Mountain House Tunnel Spring, and a deep well in Naalehu. The water from the Mountain House Tunnel is piped to Haao Springs and from there distributed to South Point, Waiohinu and Naalehu on separate lines.

Flow records taken from Stearns and MacDonald reveal the following:

	Minimum	Maximum	Average
Haao Springs ----------	170,000 gpd	1,820,000 gpd	600,000 gpd
Mountain House Tunnel -----	193,000 gpd	6,450,000 gpd	1,175,000 gpd
TOTAL	363,000 gpd	8,270,000 gpd	1,775,000 gpd

The 1969-70 drought records are not included in the above data. Flows during the drought were much lower than the minimum amounts shown above. Additional water supplies needed during the dry period were transported by truck and fed into the Naalehu System to supplement the existing sources.

In a previous lease agreement (General Lease No. 3351) with the County of Hawaii, the Hutchinson Sugar Co. (merged into C. Brewer and Co., Ltd.) was allowed the use of water from the Mountain House Tunnel. This lease expired in June 1971. Following expiration of the lease in June 1971, agreements proposed between the State of Hawaii and C. Brewer and Co., Ltd., include the County's right to use the first 100,000 gpd at Haao Springs from the 12-inch Mountain House Tunnel line. Presently, the County is requesting the State to set aside the water rights and transmission facilities within the area formerly encompassed by G. L. No. 3351 to the Water Department.

Demand

The present consumption for the Waiohinu-Naalehu area is approximately 314,000 gpd (including Discovery Harbor).

Waiohinu System

The Waiohinu system receives its water supply via the 8-inch transmission line from Haao Springs. In 1971, there were 110 services consuming an average of about 45,000 gpd. The present estimated consumption is approximately 70,000 gpd. The existing urban zoned area allows about 440 residential lots plus several commercial lots. Should these areas develop, water consumption would increase to about 200,000 gpd.

Naalehu System

The Naalehu system receives its water supply via an 8-inch transmission line from Waiohinu. The system within Naalehu Village was dedicated from the plantation to the Department of Water Supply. The present consumption is about 200,000 gpd. The Naalehu deep well, completed in 1973, also supplements the area with a pumping capacity of 0.54 mgd (375 gpm).

South Point System

The present average demand on the South Point system is 26,000 gpd. This system, installed by the Army during World War II, services the ranch lands predominant in this area.

Proposed Improvements

Developments and improvements for the Waiohinu-Naalehu-South Point systems are planned as follows: (Refer to Plate 14)

- Source

  Naalehu Deep Well No. 2

- Reservoir

  Haao 0.1-MG Reservoir, Elevation 1,625'
  Haao 50.0-MG Holding Reservoir
  Waiohinu 0.1-MG Reservoir, Elevation 1,297'
  South Point 0.1-MG Reservoir

- Booster Pump

  Discovery Harbor Booster Pump

  Naalehu-Waiohinu Booster

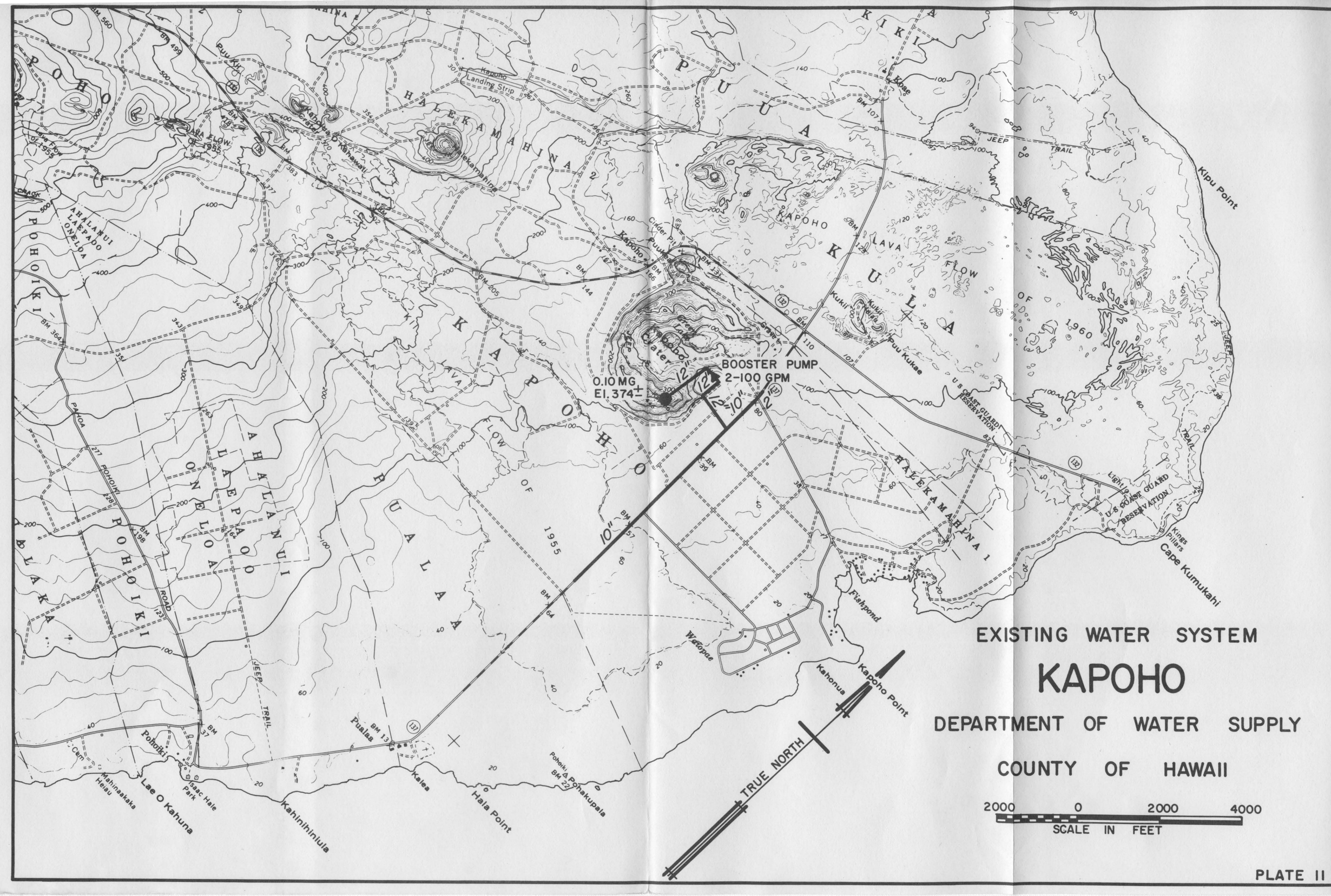
- Transmission

  Haao to South Point Transmission

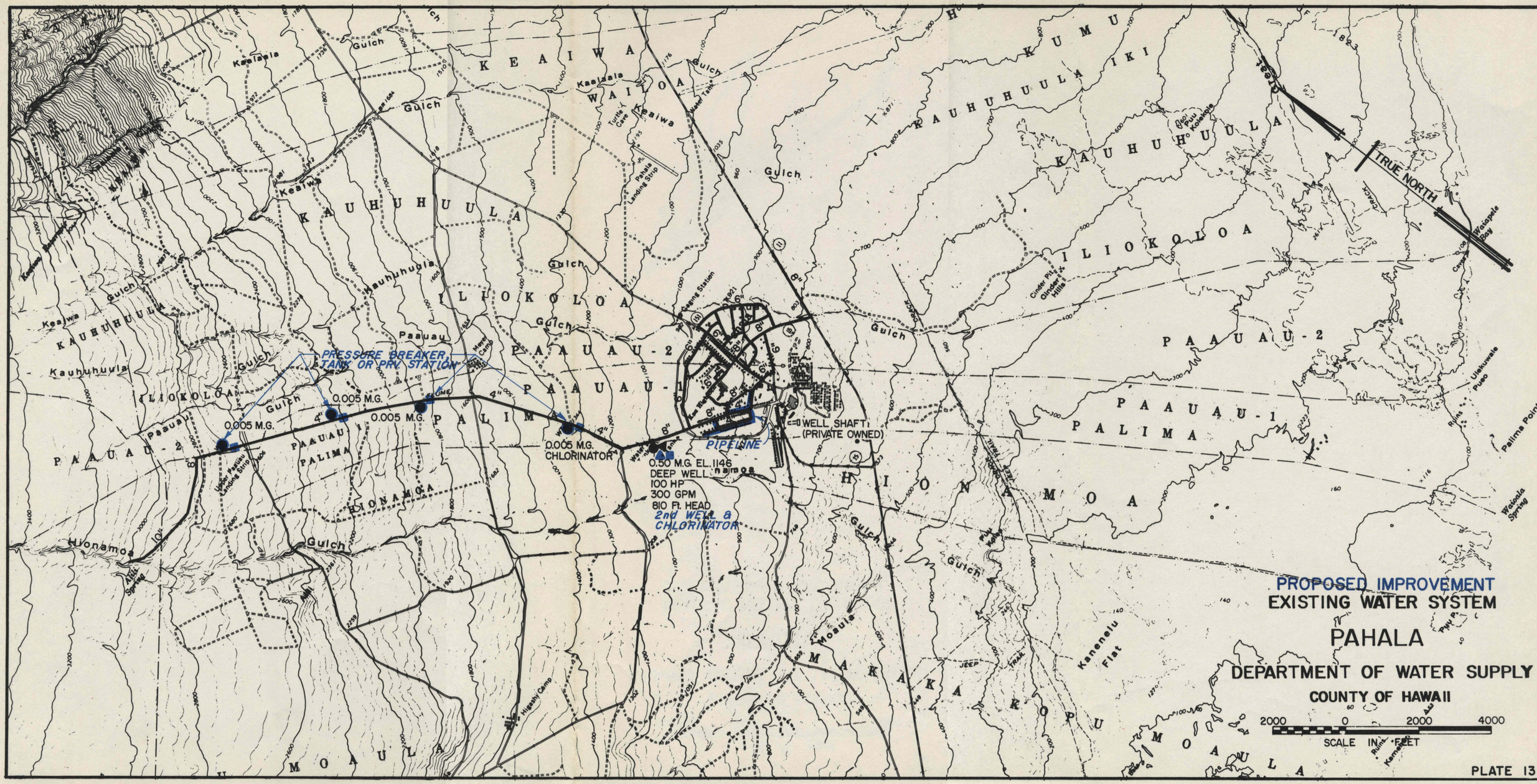
  Discovery Harbor to South Point Transmission

- Distribution

  Various Pipeline Improvements


0.10 MG
El. 374±
BOOSTER PUMP
2-100 GPM
12"
10"
2"
EXISTING WATER SYSTEM
KAPOHO
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
TRUE NORTH
2000 0 2000 4000
SCALE IN FEET
PLATE 11


SOURCE STUDY
EXPLORATORY WELL
0.10 MG
El. 800.00
KEAUOHANA
DEEP WELL
I-200 GPM
I-350 GPM
PROPOSED STORAGE
ELEV. 335'±
PIPELINE
0.50 MG
El. 345.00
3000'
8"
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
KALAPANA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
TRUE NORTH
KUPAHUA HOMESTEADS
KAIMU-MAKENA HOMESTEADS
KIKALA-KEOKEA HOMESTEADS
KEAUOHANA-KEHENA HOMESTEADS
KALAPANA
KUPAPAU POINT
HAKUMA POINT
HARRY K BROWN PARK
KAIMU BEACH
KAIMU PARK
KALAEHAMOE
PUNAHAHA
KEAUOHANA FOREST RESERVE
PLATE 12


PRESSURE BREAKER TANK OR PRV. STATION
0.005 M.G.
0.005 M.G.
0.005 M.G.
CHLORINATOR
FLUME
4"
6"
8"
PIPELINE
0.50 M.G. EL. 1146
DEEP WELL
100 HP
300 GPM
810 Ft. HEAD
2nd WELL & CHLORINATOR
WELL SHAFT
(PRIVATE OWNED)
TRUE NORTH
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
PAHALA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE 13


RESERVOIR
4" TO SOUTH PT.
TRANSMISSION
BOOSTER PUMP
0.10 MG RESERVOIR
BOT. ELEV. 1560.0
O.F. ELEV. 1574.5
0.02 MG
0.04 MG
RESERVOIR
RESERVOIR
RESERVOIR
0.05 MG RESERVOIR
BOT. ELEV. 1297.4
O.F. ELEV. 1315.4
0.05 MG RESERVOIR
BOT. ELEV. 1625.5
O.F. ELEV. 1640.0
BOOSTER PUMP
0.10 MG RESERVOIR
BOT. ELEV. 869.0
O.F. ELEV. 883.0
2nd WELL
NAALEHU DEEP WELL
ELEV. 748.0
375.0 GPM
PIPELINE
TRUE NORTH
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
WAIOHINU – NAALEHU
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
DWS PIPELINE
PLANTATION PIPELINE
PLATE 14

HYDROGRAPHIC AREA IV

PRESENT DEVELOPMENT

Population

Hydrographic Area IV occupies the southwestern portion of the island and includes a major portion of North Kona, South Kona and a portion of the Ka'u District (Figure 1). Although there are only two major water systems within Hydrographic Area IV (Figure 7), this region comprises the Big Island's fastest growing areas.

The rise in tourism especially in Kailua has brought about significant changes in the character of the Kona District. Other areas experiencing rapid growth are: Kalaoa, Kaloko, Kealakehe Keauhou and Kealakekua. Consequent to Kona's rising economy is an increase in single and multi-family housing developments. Urban sprawl is rapidly moving in a direction north of Kailua. The 1980 projected population for Hydrographic Area IV is 12,900 people. Compared with the 1970 census population of approximately 8,800 (North and South Kona), the 1980 projection represents a 47 percent growth increase. However, preliminary estimates from the 1980 census show a present population of about 20,000 people, representing a higher growth increase of 127 percent.

Water Supply

The Kona area receives minimal trade wind rainfall due to the sheltering from trade winds by Mauna Loa and Mauna Kea. Convective type showers, however, occur along the west slopes of Mauna Loa and Hualalai and provide the area with considerable rainfall. Dry zones are prevalent in the northern sector of Hydrographic Area IV and on the highest slopes of Mauna Loa and Hualalai, where the annual rainfall is 15 to 20 inches (Figure 2). The zone of greatest rainfall (75-100 inches) runs parallel with the west shore at elevations between 1,200 and 3,500 feet.

A total rainfall of 1,790 mgd has been estimated for Hydrographic Area IV (Table 1). The availability of water is limited to groundwater as there are no perennial streams in the area offering dependable supplies of water.

HYDROGRAPHIC AREA IV
WATER SYSTEMS

Keahole Point

HUALALAI

Kailua Bay

NORTH KONA SYSTEM (WELLS)

Captain Cook

Honaunau

SOUTH KONA SYSTEM (WELLS)

Milolii

N

0 5 10 Miles

South Point (Kalae)

FIGURE 7

The estimated sustainable yield for the area is approximately 100 mgd (Table 2).

Developed Sources

The Department of Water Supply maintains eight groundwater sources in Kona. The source capacities are as follows:

Source	Capacity (mgd)
Kahaluu "A"	1.0 (700 gpm)
Kahaluu "B"	1.0 (700 gpm)
Kahaluu "C"	1.0 (700 gpm)
Kahaluu "D"	1.4 (1000 gpm)
Kahaluu Shaft	6.0 (3 x 1400 gpm)
Keei "A"	0.4 (300 gpm)
Keei "B"	0.4 (300 gpm)
Keei "C"	0.7 (500 gpm)
TOTAL	11.9 mgd

1990 DEVELOPMENT

Population

The 1990 projected population of 16,100 people (Table 3) represents an increase of about 25 percent of that projected for 1980. The Kona area, considered as one of the island's major growth areas, will continue as the island's tourist center.

The outlook relative to the expansion of Kona is one of continuing developments especially between Keahole and Kailua. Keauhou stands out as another significant growth area. South Kona has also been experiencing growth, however, unlike North Kona's tourist economy, the south district's rural-agricultural complexion will restrict significant possibilities of future growth.

Demand

The 1990 municipal demand of approximately 3.5 mgd has been projected for Hydrographic Area IV as stated in the State Water Resources Development Plan, January 1980, prepared by the Department of Land and Natural Resources. However, projections by the Department of Water

Supply show a 1990 maximum daily demand of about 8.0 mgd (Figure 8), exclusive of South Kona.

KONA SYSTEM

The Kona System can be divided into the North Kona and the South Kona Systems. These systems are interconnected and therefore allows the transporting of water from one system to the other. This is done only during emergencies and at a very limited rate.

North Kona System

Source

The North Kona System is supplied by four wells and a shaft at Kahaluu. Water is pumped from the Kahaluu Wells to Mamalahoa Highway as well as to the lower areas. The Kahaluu Wells and shaft capacities are as follows:

	Capacity 24-Hour Pumping (mgd)	Cumulative Total Capacity (mgd)	Cumulative Safe Capacity (based on breakdown of one pump) (mgd)
Well A ----------	1.0	1.0	--
Well B ----------	1.0	2.0	1.0
Well C ----------	1.0	3.0	2.0
Well D ----------	1.4	4.4	3.0
Kahaluu Shaft -------	6.0	10.4	8.4

A major concern at this time is the capacity of the aquifer in the Kahaluu area. More specifically, it is presently necessary to determine how much water can be withdrawn before saltwater intrusion becomes a problem. Since major water development projects take at least five years from inception to completion, groundwater exploration programs in North Kona in the Honalo-Kealakekua area or in the vicinity of Kailua should be started immediately. Detailed planning of future source and accompanying transmission lines can then begin.

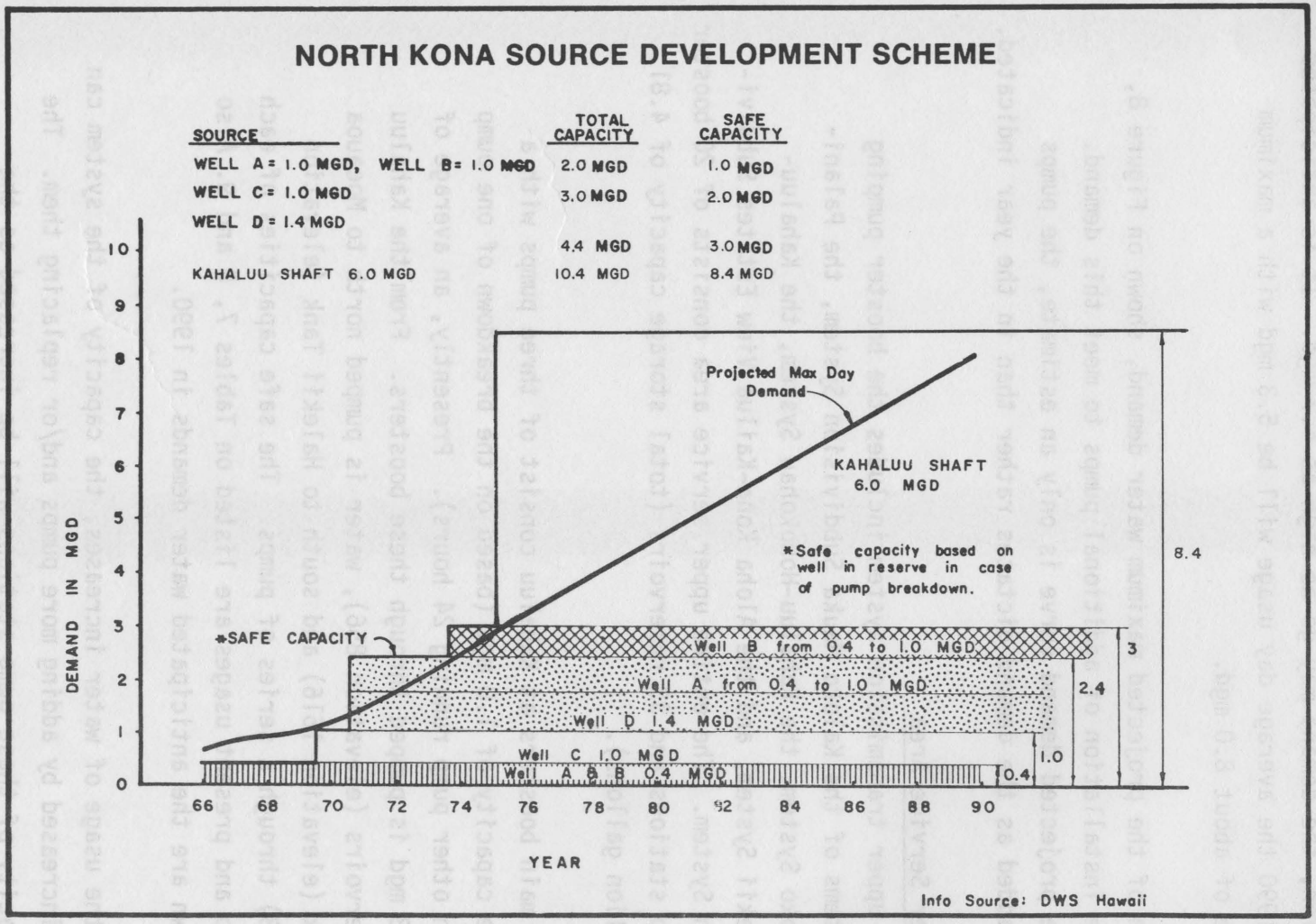

NORTH KONA SOURCE DEVELOPMENT SCHEME
SOURCE
TOTAL CAPACITY
SAFE CAPACITY
WELL A = 1.0 MGD, WELL B = 1.0 MGD
2.0 MGD
1.0 MGD
WELL C = 1.0 MGD
3.0 MGD
2.0 MGD
WELL D = 1.4 MGD
4.4 MGD
3.0 MGD
KAHALUU SHAFT 6.0 MGD
10.4 MGD
8.4 MGD
Projected Max Day Demand
KAHALUU SHAFT 6.0 MGD
*Safe capacity based on well in reserve in case of pump breakdown.
*SAFE CAPACITY
Well B from 0.4 to 1.0 MGD
Well A from 0.4 to 1.0 MGD
Well D 1.4 MGD
Well C 1.0 MGD
Well A & B 0.4 MGD
3
2.4
1.0
0.4
8.4
DEMAND IN MGD
0
1
2
3
4
5
6
7
8
9
10
66
68
70
72
74
76
78
80
82
84
86
88
90
YEAR
Info Source: DWS Hawaii

FIGURE 8

Demand

The present average water usage is about 3.1 mgd. On days of heavy consumption, the demand may go as high as 4.7 mgd. It is anticipated that by 1990 the average day usage will be 5.3 mgd with a maximum day usage of about 8.0 mgd.

The graph of the projected maximum water demand, shown on Figure 8, shows the installation of additional pumps to meet this demand. Since the projected demand curve is only an estimate, the pumps will be added as the demand dictates rather than in the year indicated.

- Upper Service Area

  The upper transmission system includes the booster pumping systems of the Kaloko Mauka Subdivision System, the Palani-Kaloko System, the Kahaluu-Honokohau System, the Kahaluu-Halekii System, and the Aloha Kona-Kailua View Estates Subdivision System. The entire upper service area consists of 20 booster pump stations and 33 reservoirs (total storage capacity of 4.81 million gallons).

  The main boosters at Kahaluu consist of three pumps with a safe capacity of 1.0 mgd (based on the breakdown of one pump with other pump running 24 hours). Presently, an average of 0.38 mgd is pumped through these boosters. From the Kahaluu reservoirs (elevation 856), water is pumped north to Moeauoa Tank (elevation 1616) and south to Halekii Tank (elevation 1763) through a series of pumps. The safe capacities of each pump and present usages are listed on Tables 7, 8 and 9. Also shown are the anticipated water demands in 1990.

  As the usage of water increases, the capacity of the system can be increased by adding more pumps and/or replacing them. The capacity of these pump stations will be increased as the need arises. The controlling factor for pump increase will be the capacity of the 8-inch mains. Larger and/or additional mains must also be installed. In summary, the final determination on where improvements are required will depend on the growth and the location of the developing areas.

TABLE 7

DEMAND VS. PUMP CAPACITY
NORTH KONA - KAHALUU TO PUAA

	1980		1990	
	Ave. Day	Max. Day	Ave. Day	Max. Day
System 761	0.03	0.05	0.40	0.60
Puaa Pump	2 pumps 100 gpm 1 - 300 gpm Safe Capacity = 0.348 Normal " = 0.232			
System 771	0.05	0.08	0.30	0.50
	0.08	0.13	0.70	1.10
Holualoa Pump	2 pumps 100 gpm 1 - 300 gpm Safe Capacity = 0.367 Normal " = 0.245			
System 772	0.01	0.02	0.06	0.09
System 773	0.01	0.01	0.10	0.15
	0.10	0.16	0.86	1.34
Kaumalumalu Pump	2 pumps 100 gpm 1 - 300 gpm Safe Capacity = 0.245 Normal " = 0.163			
System 774	0.04	0.05	0.05	0.08
	0.14	0.21	0.91	1.42

Safe capacity based on pump(s) running 24 hours/day - should be greater than maximum day consumption.

Normal capacity based on pump(s) running 16 hours/day - should be greater than average day consumption.

Pump capacity based on system curves.

TABLE 8

DEMAND VS. PUMP CAPACITY
NORTH KONA - KAHALUU TO HONUAINO

	1980		1990	
	Ave. Day	Max. Day	Ave. Day	Max. Day
System 783	0.22	0.33	0.35	0.55
Honuaino Pump	2 pumps 120 gpm 1 - 250 gpm Safe Capacity = 0.320 Normal " = 0.213			
System 782	0.10	0.15	0.12	0.20
	0.32	0.48	0.47	0.75
Honalo	2 pumps 150 gpm 1 - 300 gpm Safe Capacity = 0.562 Normal " = 0.374			
System 781	0.04	0.05	0.12	0.20
	0.36	0.53	0.59	0.95
Keauhou Pump	2 pumps 120 gpm 1 - 350 gpm Safe Capacity = 0.501 Normal " = 0.334			
System 775	0.06	0.08	0.20	0.30
	0.42	0.61	0.79	1.25
+ System Serving North	0.14	0.21	0.91	1.42
	0.56	0.82	1.70	2.67
Kahaluu Pumps	2 pumps 250 gpm 1 - 500 gpm Safe Capacity = 0.713 Normal " = 0.475			

Safe capacity based on pump(s) running 24 hours/day - should be greater than maximum day consumption.

Normal capacity based on pump(s) running 16 hours/day - should be greater than average day consumption.

Pump capacity based on system curves.

TABLE 9

DEMAND VS. PUMP CAPACITY
NORTH KONA - PALANI TO KALOKO

	1980		1990	
	Ave. Day	Max. Day	Ave. Day	Max. Day
System 750	0.24	0.36	0.38	0.57
Kaloko Mauka Booster Pumps	2 - 250 gpm pumps Safe Capacity = 0.475 Normal " = 0.317			
System 744	0.24	0.36	0.38	0.57
	0.48	0.72	0.76	1.14
Palani No. 4 Booster Pumps	2 - 200 gpm pumps Safe Capacity = 0.324 Normal " = 0.216			
System 743	0.03	0.04	0.04	0.07
	0.51	0.76	0.80	1.21
Palani No. 3 Booster Pumps	2 - 200 gpm pumps Safe Capacity = 0.295 Normal " = 0.197			
System 742	0.08	0.13	0.14	0.20
	0.59	0.89	0.94	1.41
Palani No. 2 Booster Pumps	2 - 300 gpm pumps Safe Capacity = 0.475 Normal " = 0.317			
System 741	0.00	0.00	0.00	0.00
	0.59	0.89	0.94	1.41
Palani No. 1 Booster Pumps	2 - 200 gpm pumps Safe Capacity = 0.295 Normal " = 0.197			

Safe capacity based on pump(s) running 24 hours/day - should be greater than maximum day consumption.

Normal capacity based on pump(s) running 16 hours/day - should be greater than average day consumption.

Pump capacity based on system curves.

- Lower Service Area

  The system extends from Keahole Airport to Keauhou Bay. The lower service area is fed by gravity from the Kahaluu Reservoirs through two mains along Kuakini Highway (See Plate 15). An 8-inch and a 12-inch water line delivers water requirements towards Kahaluu and Keauhou. There are eight reservoirs with a total capacity of 3.95 MG. The average daily consumption is 2.54 mgd.

  The Kahaluu Shaft, which went on line in 1975, is accompanied by two 1.0 MG reservoirs. Demand requirements in the Keahole-Kailua area are met by flows from the Kahaluu Reservoirs via the 24-inch and 20-inch mains along Kuakini Highway. The Keahole-Kailua area is fed primarily from the 20-inch line. The other main, composed of 12-inch and 8-inch pipes also provides the Keahole-Kailua area with water from the Kahaluu wells.

  The Alii Drive section is fed via the 8-inch line along Kuakini Highway as well as from the 8-inch and 12-inch transmission lines in Kahaluu. The Keauhou Bay area is served by the 12-inch transmission line from the Kahaluu Reservoir. The present demand in the Alii-Keauhou area is about 2.0 mgd.

Proposed Improvements

Developments and improvements for the systems are planned as follows: (Refer to Plate 15)

- Source

  Additional pumps at the Kahaluu Shaft
  Exploratory Wells

- Reservoir

  New Kailua 1.0-MG Reservoir, Elevation 325'±
  Palani Reservoir, Elevation 935'±
  Laaloa 0.3-MG Reservoir, Elevation 325'±
  Keauhou 0.3-MG Reservoir, Elevation 325'±
  Moeauoa Reservoir, Elevation 1604± (Mamalahoa)

- Booster Pumps

  Palani-Kaloko Boosters

  Mamalahoa Booster - North

  Mamalahoa Boosters - South

  Kahaluu Booster

- Transmission

  Kuakini Transmission

  Mamalahoa Transmission - North

  Mamalahoa Transmission - South

  Palani-Kaloko Transmission

- Distribution

  Various pipeline improvements

  Alii Drive Pipeline - Kailua

  Alii Drive Pipeline - Kahaluu

- Other

  Epoxy line existing steel tanks

  Waiaha Intake Study

  New Base Yard/Office Complex

  Kailua Well Study

South Kona System

Source

The South Kona System is supplied by three wells at Keei with a total capacity of 1.58 mgd and a safe capacity of 0.79 mgd.

Demand

The average usage is 0.56 mgd, however, a demand as high as 0.84 mgd has been experienced during heavy consumption periods. Like the North Kona System, the South Kona System can be divided into upper and lower service areas.

- Upper Service Area

  From Keei Wells (elevation 766), the water supply is lifted by a series of booster pumps to Mamalahoa Highway (elevation 1,376 feet). Further lifting to the north is accomplished by a series of booster pumps to a tank at Waipunaula (elevation

1,764). Flow to the south is by gravity to Hookena Beach Road junction. The upper system consists of about 10 miles of 8-inch pipeline, five pump stations and seven reservoirs. The total storage capacity is 0.90 mg (million gallons).

The present water demand in this area is 0.46 mgd. Should development of all lands zoned for one acre or less occur, the demand could reach 0.63 mgd.

- Lower Service Area

  This area comprises mostly of the Honaunau Bay, City of Refuge area. It is served by a 4-inch and an 8-inch line. The present average usage is 0.10 mgd.

The capacity of each pump station and present usages are listed on Table 10. Also presented is the anticipated 1990 demand.

Proposed Improvements

Developments and improvements for the systems are planned as follows: (Refer to Plate 16)

- Source

  Exploratory Wells

- Reservoirs

  Keokea 0.1-MG Reservoir, Elevation 1,150'±
  City of Refuge 0.1-MG Reservoir, Elevation 400'±
  Keei No. 1 Reservoir, Elevation 766'±

- Booster Pump

  Increase pumping capacities at existing stations

- Transmission

  Captain Cook to Napoopoo 8-inch Transmission, 13,000'
  Keei No. 1 to Keei No. 2 Transmission

- Other

  Epoxy line existing steel tanks

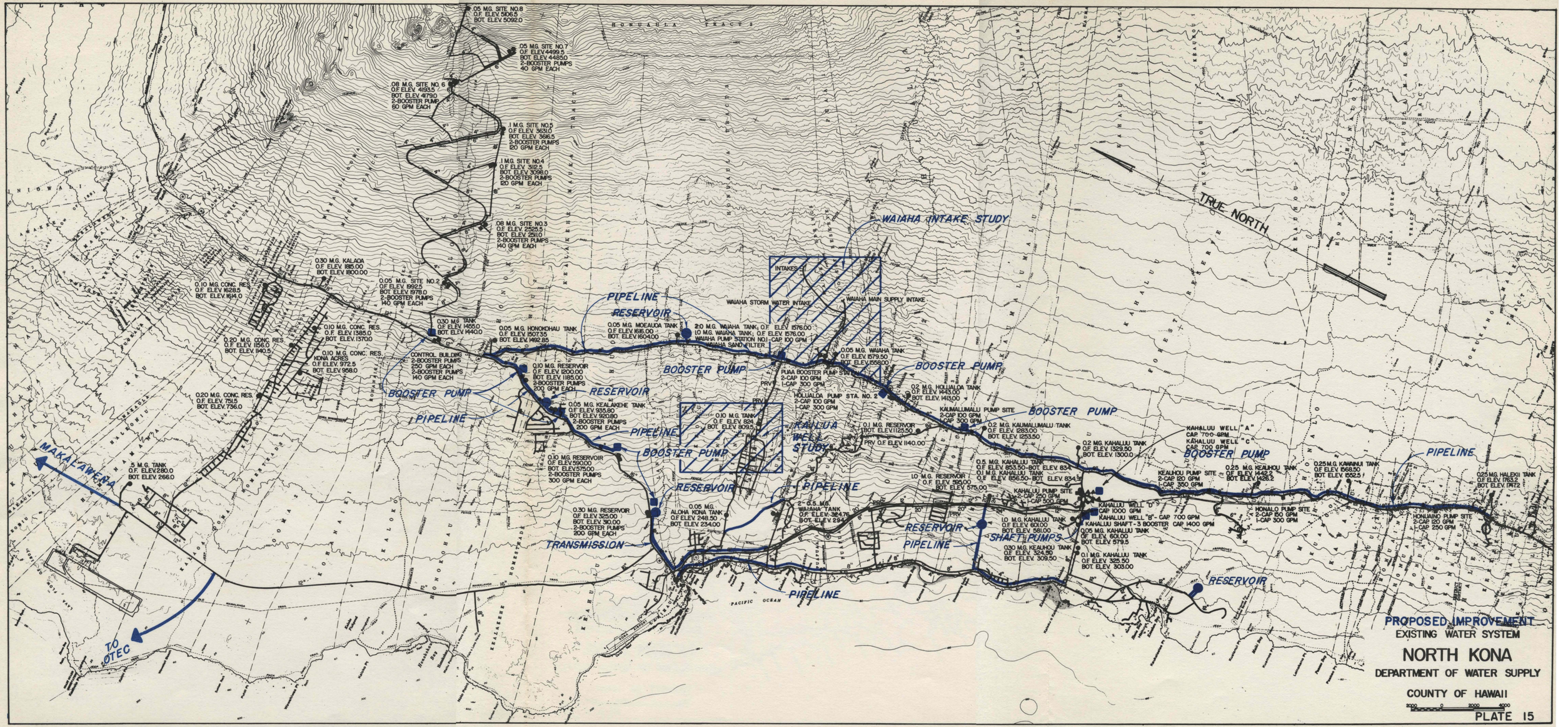
TABLE 10

DEMAND VS. PUMP CAPACITY
SOUTH KONA

	1980		1990	
	Ave. Day	Max. Day	Ave. Day	Max. Day
System 800	0.11	0.16	0.60	0.90
Keei Booster Pump No. 4	2 - 100 gpm pumps 1 - 265 gpm Safe Capacity = .288 Normal " = .192			
System 810	0.01	0.02	0.06	0.09
	0.11	0.18	0.66	0.99
Keei Booster Pump No. 3	2 - 100 gpm pumps 1 - 275 gpm Safe Capacity = .288 Normal " = .192			
System 820	0.09	0.14	0.10	0.15
	0.20	0.32	0.76	1.14
Keei Booster Pump No. 2	2 - 100 gpm pumps 1 - 300 gpm Safe Capacity = .288 Normal " = .192			
System 830	0.06	0.09	0.08	0.12
	0.26	0.41	0.84	1.26
Keei Booster Pump No. 1	2 - 100 gpm pumps 1 - 300 gpm Safe Capacity = .288 Normal " = .192			

Safe capacity based on pump(s) running 24 hours/day - should be greater than maximum day consumption.

Normal capacity based on pump(s) running 16 hours/day - should be greater than average day consumption.


.05 MG. SITE NO.8
O.F. ELEV. 5106.5
BOT. ELEV. 5092.0
.05 MG. SITE NO.7
O.F. ELEV. 4499.5
BOT. ELEV. 4485.0
2-BOOSTER PUMPS
40 GPM EACH
.08 M.G. SITE NO. 6
O.F. ELEV. 4193.5
BOT. ELEV. 4179.0
2-BOOSTER PUMPS
80 GPM EACH
1 M.G. SITE NO.5
O.F. ELEV. 3631.0
BOT. ELEV. 3616.5
2-BOOSTER PUMPS
120 GPM EACH
1 M.G. SITE NO.4
O.F. ELEV. 3112.5
BOT. ELEV. 3098.0
2-BOOSTER PUMPS
120 GPM EACH
.08 M.G. SITE NO.3
O.F. ELEV. 2525.5
BOT. ELEV. 2511.0
2-BOOSTER PUMPS
140 GPM EACH
.05 M.G. SITE NO.2
O.F. ELEV. 1992.5
BOT. ELEV. 1978.0
2-BOOSTER PUMPS
140 GPM EACH
.30 M.G. KALAOA
O.F. ELEV. 1815.00
BOT. ELEV. 1800.00
.10 M.G. CONC. RES.
O.F. ELEV. 1628.5
BOT. ELEV. 1614.0
.30 M.G. TANK
O.F. ELEV. 1455.0
BOT. ELEV. 1440.0
.10 M.G. CONC. RES.
O.F. ELEV. 1385.0
BOT. ELEV. 1370.0
.20 M.G. CONC. RES.
O.F. ELEV. 1156.0
BOT. ELEV. 1140.5
.10 M.G. CONC. RES.
KONA ACRES
O.F. ELEV. 972.5
BOT. ELEV. 958.0
.20 M.G. CONC. RES.
O.F. ELEV. 751.5
BOT. ELEV. 736.0
.5 M.G. TANK
O.F. ELEV. 280.0
BOT. ELEV. 266.0
MAKALAWEENA
TO OTEC
CONTROL BUILDING
2-BOOSTER PUMPS
250 GPM EACH
2-BOOSTER PUMPS
140 GPM EACH
.05 M.G. HONOKOHAU TANK
O.F. ELEV. 1507.35
BOT. ELEV. 1492.85
.10 M.G. RESERVOIR
O.F. ELEV. 1200.00
BOT. ELEV. 1185.00
2-BOOSTER PUMPS
200 GPM EACH
.05 M.G. KEALAKEHE TANK
O.F. ELEV. 935.80
BOT. ELEV. 920.80
2-BOOSTER PUMPS
200 GPM EACH
.10 M.G. RESERVOIR
O.F. ELEV. 590.00
BOT. ELEV. 575.00
2-BOOSTER PUMPS
300 GPM EACH
.30 M.G. RESERVOIR
O.F. ELEV. 325.00
BOT. ELEV. 310.00
2-BOOSTER PUMPS
200 GPM EACH
.05 M.G. ALOHA KONA TANK
O.F. ELEV. 248.50
BOT. ELEV. 234.00
.05 M.G. MOEAUOA TANK
O.F. ELEV. 1616.00
BOT. ELEV. 1604.00
2.0 M.G. WAIAHA TANK; O.F. ELEV. 1576.00
1.0 M.G. WAIAHA TANK; O.F. ELEV. 1576.00
WAIAHA PUMP STATION NO.1-CAP 100 GPM
WAIAHA SAND FILTER
WAIAHA STORM WATER INTAKE
WAIAHA MAIN SUPPLY INTAKE
INTAKES
WAIAHA INTAKE STUDY
.05 M.G. WAIAHA TANK
O.F. ELEV. 1579.50
BOT. ELEV. 1558.00
PUMA BOOSTER PUMP STA.
2-CAP 100 GPM
1-CAP 300 GPM
HOLUALOA PUMP STA. NO. 2
2-CAP 100 GPM
1-CAP 300 GPM
.10 M.G. TANK
O.F. ELEV. 824.
BOT. ELEV. 809.5
KAHALUA WELL STUDY
.02 M.G. HOLUALOA TANK
O.F. ELEV. 1443.00
BOT. ELEV. 1413.00
.01 M.G. RESERVOIR
BOT. ELEV. 1125.50
PRV O.F. ELEV. 1140.00
KAUMALUMALU PUMP SITE
2-CAP 120 GPM
1-CAP 300 GPM
.02 M.G. KAUMALUMALU TANK
O.F. ELEV. 1283.00
BOT. ELEV. 1253.50
.02 M.G. KAHALUU TANK
O.F. ELEV. 1329.50
BOT. ELEV. 1300.0
KAHALUU WELL "A"
CAP 700 GPM
KAHALUU WELL "C"
CAP 700 GPM
.5 M.G. KAHALUU TANK
O.F. ELEV. 853.50-BOT. ELEV. 834.5
.01 M.G. KAHALUU TANK
O.F. ELEV. 856.50-BOT. ELEV. 834.5
LO M.G. RESERVOIR
O.F. ELEV. 595.00
BOT. ELEV. 575.00
KAHALUU PUMP SITE
2-CAP 150 GPM
1-CAP 500 GPM
KAHALUU WELL "D"
CAP 1000 GPM
KAHALUU WELL "B"- CAP 700 GPM
KAHALUU SHAFT-3 BOOSTER CAP 1400 GPM
LO M.G. KAHALUU TANK
O.F. ELEV. 601.00
BOT. ELEV. 581.00
.05 M.G. KAHALUU TANK
O.F. ELEV. 601.00
BOT. ELEV. 579.5
.020 M.G. KEAUHOU TANK
O.F. ELEV. 324.00
BOT. ELEV. 309.50
.01 M.G. KAHALUU TANK
O.F. ELEV. 325.50
BOT. ELEV. 303.00
KEAUHOU PUMP SITE
2-CAP 120 GPM
1-CAP 350 GPM
.25 M.G. KEAUHOU TANK
O.F. ELEV. 1442.2
BOT. ELEV. 1426.2
.25 M.G. KAWAINUI TANK
O.F. ELEV. 1568.50
BOT. ELEV. 1552.5
HONALO PUMP SITE
2-CAP 150 GPM
1-CAP 300 GPM
.25 M.G. HALEKII TANK
O.F. ELEV. 1783.2
BOT. ELEV. 1767.2
HONUAINO PUMP SITE
2-CAP 120 GPM
1-CAP 250 GPM
BOOSTER PUMP
RESERVOIR
PIPELINE
TRANSMISSION
SHAFT PUMPS
TRUE NORTH
PACIFIC OCEAN
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
NORTH KONA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
PLATE 15


PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
SOUTH KONA
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
PLATE 16
2000 0 2000 4000
SCALE IN FEET
TRUE NORTH
PUMP STA. 2-120 GPM 1-250 GPM
0.25 MG TANK El. 1763.2/1747.2
0.25 MG TANK El. 1764.30'/1734'
0.05 MG TANK El. 1598.50'/1577'
PUMP STA. 2-100 GPM 1-265 GPM
BOOSTER 2-100 GPM 1-275 GPM
0.2 MG TANK El. 1376.25'/1346.75
BOOSTER 2-100 GPM 1-300 GPM
0.05 MG TANK El. 1063.50'/1042
BOOSTER 2-100 GPM 1-300 GPM
KEEI WELL No. A 300 GPM
0.05 MG TANK EL. 766.5'/1042
KEEI WELL No. B 300 GPM
0.05 MG RES. El. 899.5/884
KEEI WELL No. C 500 GPM
BOOSTER 2-400 GPM
0.30 MG RES El. 309/293
BOOSTER PUMP
TRANSMISSION
RESERVOIR
RESERVOIR & BOOSTER PUMP
RESERVOIR
TRANSMISSION
RESERVOIR
RESERVOIR
RESERVOIR
CITY OF REFUGE NATIONAL HISTORICAL PARK
KEALAKEKUA BAY
Honaunau Bay
Kauhako Bay
Keawekaheka Bay
Mokuakae Bay
Cook Point
Captain Cook
Napoopoo
Keei
Honaunau
Hookena
Kealia
Kiilae
Keokea
Kauleoli
KEOPUKA
Keawekaheka Point
NORTH KONA
SOUTH KONA
DISTRICT BOUNDARY

HYDROGRAPHIC AREA V

PRESENT DEVELOPMENT

Population

Hydrographic Area V, encompassing the northwest zone of the island, is composed of the South Kohala District and portions of the North Kohala, North Kona and Hamakua Districts (Figure 1). The extent of the South Kohala Water System is shown in Figure 9[1/]. The significant population areas are: Kamuela, Kawaihae, and Puako. Growth, which was initially confined within the Kona area, has begun its encroachment into the South Kohala District. As a result, South Kohala is also considered as one of the island's major growth areas.

In the past, the South Kohala District has experienced very limited growth as reflected by the 1970 census population of approximately 2,300 people. However, relative to the County of Hawaii's 1980 projection of 4,000 people, it is apparent that South Kohala is growing at an extreme rate.

Water Supply

Out of the five Hydrographic Areas, Hydrographic Area V receives the least amount of rainfall. This is apparent in Figure 2. The lowest mean annual rainfall on the island of 10 inches occurs along the Kawaihae-Puako coast. The highest amount of 50-75 inches occurs along the southwest slope of the Kohala Mountain. From Table 1, Hydrographic Area V receives approximately 1,160 mgd, out of which 60 mgd remains as the region's sustainable yield (Table 2).

The projected 1980 municipal demand for Hydrographic Area V of about 0.7 mgd, as presented in Table 4, is presently generated within the Kamuela area. There is, however, a noticeable increase in housing developments west (Kawaihae) of Kamuela.

[1/] The South Kohala Water System is a surface water supply system whose source is situated within the region.

HYDROGRAPHIC AREA V
WATER SYSTEMS

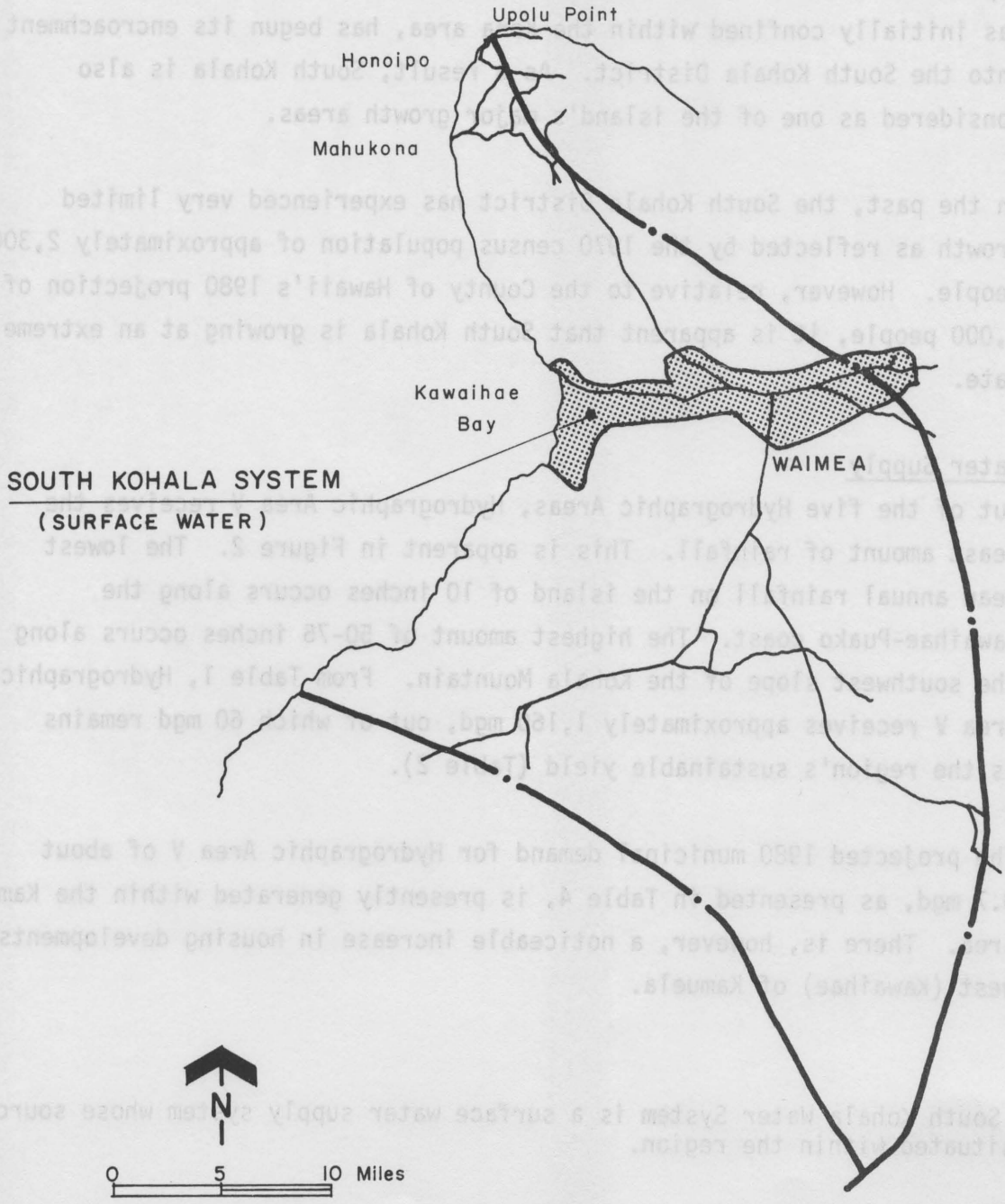


FIGURE 9

Developed Sources

The major source of water serving the requirements in Hydrographic Area V is obtained from two streams (Waikoloa and Kohakohau Streams). The water is treated at the Waimea Treatment Plant and serves the Kamuela area. The Kawaihae-Puako area is served by 2 wells in addition to a supplemental amount from the above surface supply. The Lalamilo Wells, located at about elevation 1,150 feet, also provide additional water to the Kawaihae-Puako area. The source capacities are as follows:

Source	Capacity (mgd)
Waimea Treatment Plant	4.00
Kawaihae Well	0.65 (450 gpm - 24 hr.)
Lalamilo Well	1.40
TOTAL	6.05 mgd

1990 DEVELOPMENT

Population

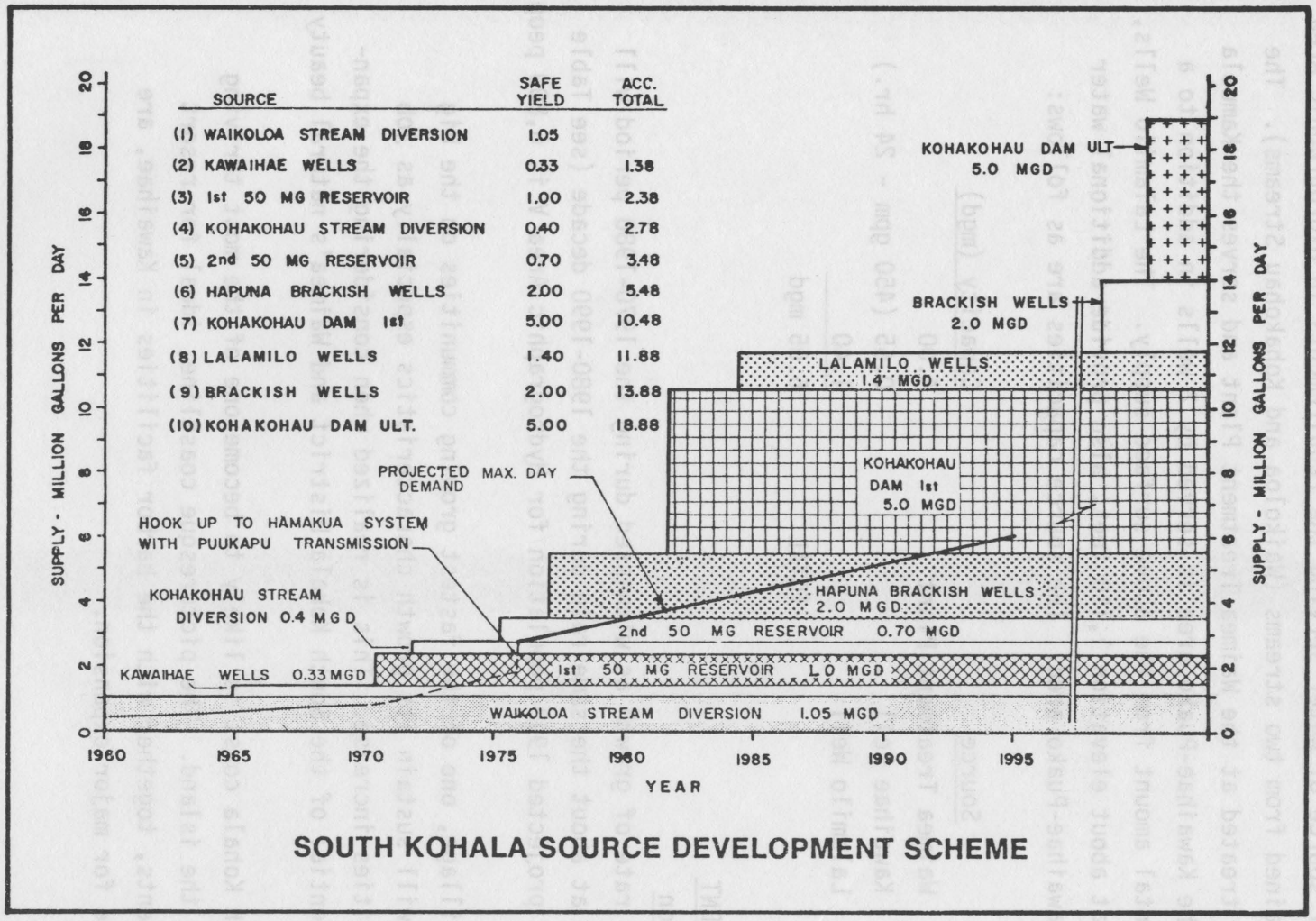
The high rate of growth as witnessed during the 1970-1980 period will continue at about the same rate during the 1980-1990 decade (see Table 3). The projected 1990 population for Hydrographic Area V is 6,800 people.

Waimea Village, one of the fastest growing communities on the Big Island, will sustain its growth characteristics especially as job opportunities increase. This is realized when considering the expansive potential of the South Kohala District and Waimea's natural beauty.

The South Kohala coast is likely to become one of the most thriving areas on the island. The picturesque coastline, ideal for resort developments, together with the harbor facilities in Kawaihae, are conducive for major expansion.

Demand

The projected 1990 municipal demand for Hydrographic Area V is approximately 1.3 mgd as stated in the State Water Resource Development Plan, January 1980, prepared by the Department of Land and Natural Resources. However, projections by the Department of Water Supply show a 1990 maximum daily demand of about 5.1 mgd (Figure 10).



SOUTH KOHALA SOURCE DEVELOPMENT SCHEME

FIGURE 10

SOUTH KOHALA SYSTEMS

Description

The South Kohala District has two consumption areas. The Puukapu-Nienie section extends from the Waimea Treatment Plant to Hamakua. The Waimea-Kawaihae section extends from the treatment plant to the Kawaihae coast. (See Plates 17 and 18).

Source

The sources feeding the South Kohala System are the Waikoloa and Kohakohau Streams. The Kawaihae and Puako areas are also supplemented by two deep wells drilled at the 570 feet elevation and two wells at the 1,150 feet elevation (Lalamilo Wells). Figure 10 presents the source development scheme for South Kohala.

Flow from the streams vary greatly with weather changes. During extended drought periods, the surface sources alone are not sufficient to meet the demand. Large reservoirs are therefore required to sustain an adequate supply during these periods. Presently, the system within the Waimea Village area has five reservoirs with a total capacity of 128.5 million gallons.

Demand

The present maximum day consumptions for the Puukapu-Nienie and Waimea-Kawaihae sections are 1.00 mgd and 0.76 mgd, respectively.

Proposed Improvements

Developments and improvements for the system are planned as follows: (Refer to Plates 17 and 18).

- Source
  Lalamilo Source Development

- Treatment
  Waimea Treatment Plant, Phase III

- Reservoir

  Third Storage Reservoir

  Lalamilo Storage and Transmission

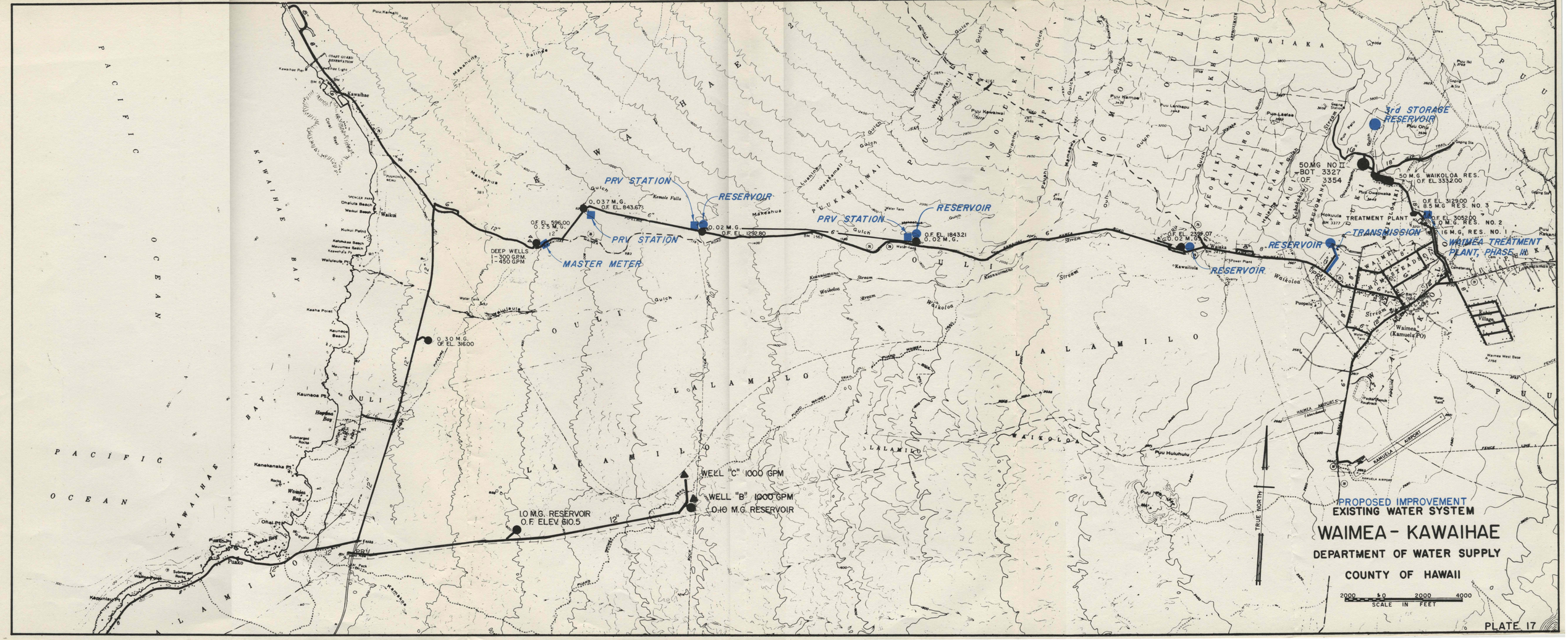
  Mana Road Redwood Tank Replacements

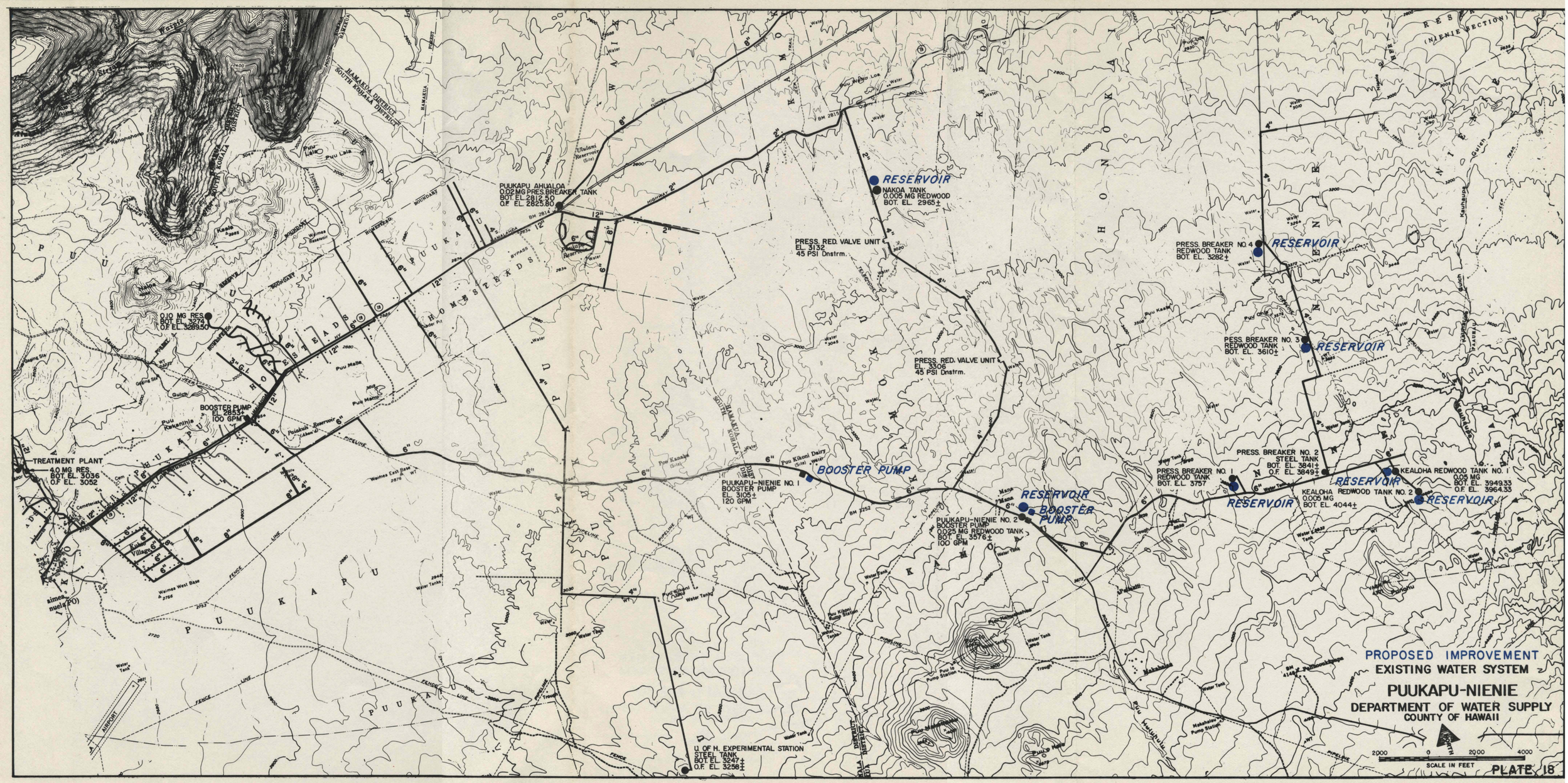
- Booster Stations

  Mana Road Booster Pumps

- Other

  PRV Stations/Reservoirs Along Kawaihae Road


PACIFIC OCEAN
KAWAIHAE BAY
PRV STATION
0.037 M.G.
O.F. EL. 843.67
RESERVOIR
0.02 M.G.
O.F. EL. 1292.80
MASTER METER
O.F. EL. 926.00
0.25 M.G.
DEEP WELLS
1 - 300 GPM
1 - 450 GPM
0.30 M.G.
O.F. EL. 316.00
PRV STATION
RESERVOIR
O.F. EL. 1843.21
0.02 M.G.
O.F. EL. 2399.07
0.02 M.G.
RESERVOIR
3rd STORAGE RESERVOIR
Puu Ohi
50 M.G. NO II
BOT 3327
O.F. 3354
50 M.G. WAIKOLOA RES.
O.F. EL. 3332.00
O.F. EL. 3129.00
8.5 M.G. RES. NO. 3
O.F. EL. 3052.00
5.0 M.G. RES. NO. 2
2.16 M.G. RES. NO. 1
Hokuula TREATMENT PLANT
TRANSMISSION
WAIMEA TREATMENT PLANT, PHASE III
RESERVOIR
WELL "C" 1000 GPM
WELL "B" 1000 GPM
1.0 M.G. RESERVOIR
1.0 M.G. RESERVOIR
O.F. ELEV. 810.5
Waimea (Kamuela PO)
KAMUELA AIRPORT
TRUE NORTH
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
WAIMEA - KAWAIHAE
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
2000 0 2000 4000
SCALE IN FEET
PLATE 17


PUUKAPU AHUALOA
0.02 MG PRES. BREAKER TANK
BOT. EL. 2812.50
O.F. EL. 2825.80
RESERVOIR
NAKOA TANK
0.005 MG REDWOOD
BOT. EL. 2965±
PRESS. RED. VALVE UNIT
EL. 3132
45 PSI Dnstrm.
PRESS BREAKER NO. 4
REDWOOD TANK
BOT. EL. 3282±
RESERVOIR
PESS BREAKER NO. 3
REDWOOD TANK
BOT. EL. 3610±
RESERVOIR
PRESS. RED. VALVE UNIT
EL. 336
45 PSI Dnstrm.
0.10 MG RES.
BOT. EL. 3274
O.F. EL. 3289.50
BOOSTER PUMP
EL. 2861±
100 GPM
TREATMENT PLANT
4.0 MG RES.
BOT. EL. 3036
O.F. EL. 3052
BOOSTER PUMP
PUUKAPU-NIENIE NO. 1
BOOSTER PUMP
EL. 3105±
120 GPM
RESERVOIR
BOOSTER PUMP
PUUKAPU-NIENIE NO. 2
BOOSTER PUMP
0.025 MG REDWOOD TANK
BOT. EL. 3576±
100 GPM
PRESS. BREAKER NO. 2
STEEL TANK
BOT. EL. 3841±
O.F. EL. 3849±
PRESS BREAKER NO. 1
REDWOOD TANK
BOT. EL. 3757
RESERVOIR
RESERVOIR
KEALOHA REDWOOD TANK NO. 1
0.05 MG
BOT. EL. 3949.33
O.F. EL. 3964.33
KEALOHA REDWOOD TANK NO. 2
0.005 MG
BOT. EL. 4044±
RESERVOIR
U. OF H. EXPERIMENTAL STATION
STEEL TANK
BOT. EL. 3247±
O.F. EL. 3258±
PROPOSED IMPROVEMENT
EXISTING WATER SYSTEM
PUUKAPU-NIENIE
DEPARTMENT OF WATER SUPPLY
COUNTY OF HAWAII
NORTH
2000 0 2000 4000
SCALE IN FEET
PLATE 18

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APPENDIX

COMMUNITY DEVELOPMENT PLAN (CDP)

As direct outgrowths of the County General Plan (adopted 1971), the Community Development Plans for each planning district provide detailed programs for the implementation of the General Plan. The CDP is based on the goals, policies, standards and courses of action which have been set forth in the General Plan.

The following policies and standards relating to public water supplies were taken from the County of Hawaii General Plan:

Water Conservation?

Policies

- All water systems shall be designed and built to Department of Water Supply standards.

- Improve and replace inadequate systems as finances and priorities permit.

- Water sources shall be adequately protected to prevent depletion and contamination from natural and man-made occurrences or events.

- New public water systems should be first installed in urban areas which have established needs and characteristics, such as occupied dwellings and other uses, or in areas adjacent to them if there is need for urban expansion, or to further the expansion of the agricultural industry.

- Additional source supplies shall be explored to ensure sufficient quantities of water for future needs. At the same time, it is essential to develop management programs to assure proper use and adequate protection of these sources.

- Fire prevention systems shall be coordinated with water distribution systems in order to ensure water supplies for firefighting purposes wherever possible.

Standards

- Water systems shall meet the requirements of the Department of Water Supply and the Subdivision Ordinance.

OTHER CONSIDERATIONS

- With respect to diversified agriculture in Hawaii, the responsibility for irrigation water use is assumed by the State. In general, the idea of separate controls on agricultural water use should be maintained in view of added costs of treatment for domestic supplies as a consequence of new water quality requirements. This would mitigate added costs to potable supply systems and public users. Considerations, however, should be made by the County on high value cash crops. Water costs to support the production of orchids, anthuriums, and etc., are relatively insignificant when compared with resulting crop revenues.

- Future minimum streamflow requirements may impose limitations on the use and development of surface water supplies (streams). The implications are somewhat reduced with respect to streams on the Island of Hawaii since perennial streams are generally non-existent. Should minimum flow requirements be established, it is desirable to institute stream studies on a case by case basis. It is necessary to consider each situation in assessing the various tradeoffs made to provide for domestic water needs.

- To assure consistency between planning documents, recommendations in the present CDP's should be revised and updated to reflect improvements as listed in this Master Plan.